FARM INSECTS.

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CORN CROPS.

Larvae and Parasites of Chlorops, a two winged fly infesting Corn crops.

J. Curtis. J. H. Le K.

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FARM INSECTS:

BEING THE

NATURAL HISTORY AND ECONOMY OF THE

INSECTS INJURIOUS TO THE FIELD CROPS

OF

GREAT BRITAIN AND IRELAND,

AND ALSO THOSE WHICH

INFEST BARNS AND GRANARIES.

WITH SUGGESTIONS FOR THEIR DESTRUCTION.

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ILLUSTRATED WITH NUMEROUS ENGRAVINGS.

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INTRODUCTION.

BEFORE entering upon the subject of this volume—"The Insects Injurious to the Agricultural Crops of Great Britain"—it will be advisable for me to state my object in offering my remarks to the attention of those who have an interest in the soil.

It is not within my province to write an Essay on Agriculture, but I cannot help stating my belief that it is too lightly esteemed by a numerous section of our population engaged in manufactures and commerce, who seem to consider it a matter of little importance, whether we grow sufficient corn for ourselves, or rely mainly for our supplies upon foreign countries. Although, however, I have no intention to discuss the importance of agriculture, I confess myself one of those who consider it the basis of the wealth and prosperity of this country; and I, therefore, strongly feel, that no time can be ill spent which is devoted to the investigation of any subject that bears upon the culture of the land, and is likely to aid in multiplying the produce and benefiting the producer.

Whilst Chemistry and Geology have lent their valuable assistance in rendering the land more fertile, little attention has, comparatively, been paid to those noxious animals which annually consume an amount of produce that sets calculation at defiance; and, indeed, if an approximation could be made to the quantity thus destroyed, the world would remain sceptical of the result obtained, considering it too marvellous to be received as truth. If the same diligence were exercised by the farmer in destroying rats, mice, sparrows, &c., as is shown for the preservation of game, the producer and consumer would alike be benefited to a vast amount; and if insect ravages could be brought more under control, by lessening the number of these destructives whenever they appear in excess, the benefit would exceed everything of which at present we have any conception. But all interference with the laws of the Creator is limited. Man is not allowed to extirpate, though he is permitted to reduce and restrain these pests within narrowed limits.

If we take only a casual glance at the annual destruction caused by insects to our growing turnip, corn, and clover crops, the above assertions will become incontrovertible facts. Again, the waste and injury sustained in granaries and barns is enormous; and with corn, it happens, unfortunately, that the loss is greatest when prices are highest, owing to its having remained longer in store or in bond. During the war waged at the beginning of the present century, insects revelled amongst stored corn unmolested for years, till the sacks and their contents became masses of living maggots, moths, beetles, &c. The heaps of grain swarmed with hosts of them, and resembled enormous ant-hills; they were in reality valueless as wholesome food, but much of them was ground up and mixed with genuine flour, and became, it is believed, the cause of serious diseases.

To augment his produce has ever been the laudable object of the farmer, and my endeavour will be to supply him with such information as may tend to show him how to diminish his losses, by directing his attention to the general economy of such insects as are likely to injure his crops. It cannot be expected that success will at once attend our efforts; but it may be hoped that, the data once ascertained, and facts correctly recorded, good results will soon follow from the dissemination of sound practical knowledge. Valuable information, it is hoped, will at least be afforded to those who thirst after knowledge; and rational amusement provided for amateur agriculturists and men of leisure who possess any taste for natural history.

I rejoice to find these important subjects receiving attention from the governmenst of France and the United States. Why then should the government of our own enlightened country be behind others in this respect? There can be only one reason for such backwardness. Natural history is not yet sufficiently appreciated at our universities and other places of education. Little or no encouragement is given to those who pursue the study; and, consequently, they have no inducement to indulge in such a taste, unless they happen to be encouraged by their parents, or by some accidental circumstance which enables them to do so. It would be well to have natural history classes in every school; and it is greatly to be desired that the principles of natural history should be taught to every one in our universities. The study of economic entomology should also be specially attended to in our agricultural colleges. It is evident from the thousands of copies of Kirby and Spence's *Introduction to Entomology*, which have been recently circulated, that there is a great desire in this country to become acquainted with the wonderful economy and history of the beautiful and curious little animals of the insect race; and it is my earnest hope that this volume may prove acceptable and instructive to very many who are engaged in agricultural pursuits.

Insects which the multitude abhor and despise, and which in the eyes of the unreflecting appear to be "a feeble race," are nevertheless accounted among "the great armies of the living God;" and must therefore be deserving our serious consideration. The economy of many among them has interested man from the earliest ages. When employed by Providence as means of scourging mankind, they became objects of terror, and were even worshipped by many idolatrous nations. In proportion as the inhabitants of the earth became civilized, and the sciences were cultivated, natural history became a favourite pursuit with some of the most distinguished philosophers of antiquity. About the commencement of the last century, it took its legitimate place amongst the sciences, owing to the especial attention paid to it by Ray, Linnæus, and others. The works of Reaumur, published in France in 1734, and of De Geer, in Sweden in 1752, opened fresh fields of interest and inquiry, by the admirable memoirs contained in them on the history and metamorphoses of the different orders of insects found in France and Sweden; and it is very gratifying to know, that able and talented men in other countries are at the present day deeply interested in these pursuits. In America, the late Dr. T. W. Harris published a handsome volume on the insects injurious to vegetation; and Dr. Asa Fitch is assiduous in the prosecution of his investigations, which have been detailed in some excellent papers. In France, M. Guérin Méneville and his coadjutors have given admirable proofs of their extensive and careful researches; and M. Bazin has commenced a series of memoirs upon the immediate subject of our inquiries, which promise greatly to advance our knowledge of the farmer's insect enemies in France. Dr. Passerini of Florence, has from time to time published many admirable essays on the insects destructive to the crops of Italy; and the entomological savans of Germany have long been foremost in elucidating insect economy, and in publishing their interesting discoveries.

Much still remains to be done by practical men; but from the long and careful attention which I gave to my original reports in the *Agricultural Journal*, very little additional matter has been furnished since their publication by those who are most favourably circumstanced for making observations; such additions, however, as have been made since my fifteenth report, will be introduced in their proper places.

The Royal Agricultural Society, at their foundation, were fully aware of the importance of this subject, and finding how impossible it was to obtain correct information on the insects injurious to our crops, owing to the papers which treated on such matters being scattered throughout expensive works, often written in foreign languages, the council invited me to prepare a series of reports upon the insects affecting the various crops cultivated in Great Britain and Ireland. I had already collected a large amount of information, which had been accumulating during the twenty years I was engaged in writing my *British Entomology*. My subsequent connection with Dr. Lindley's *Gardener's Chronicle* from its commencement, had also afforded me great advantages, from the information and data I was able to obtain from every part of the kingdom.* I came, therefore, fully prepared to the task which I had undertaken, namely, to give in detail the history and habits of the insects injurious to our turnip, corn, and other crops, explaining the transformations they undergo in their several stages, from the egg to the perfect state, whether beetle, butterfly, moth, or fly. I have drawn up careful descriptions of the species, which will be found accompanied by correct figures in illustration of most of them. Nearly all the drawings have been made by myself from nature, and were engraved under my own inspection. Whatever remedies or means of checking the ravages of insects noxious to the farmer, have been proposed and found advisable, have been introduced and discussed; and the natural parasites and other means provided by Providence to keep in check the insect race, have been duly noticed.

* I believe it is now generally known that the essays published in that journal, under the signature of "Ruricola," were written by the author of this volume.

In the following pages, I commence with the turnip crop, investigating the several species which live upon the leaves, those which inhabit the flowers, such as devour the seed, and those which injure and destroy the roots. I then pass on to the cereals, and investigate the history of the insects which cause abortion either by inroads on the flowers, or by reducing the supply of sap to the germen; of those which attack the foliage, and of such as cause the roots to perish. I next proceed to the barn and granary, and describe the beetles and moths, together with their larvæ, which subsist upon stored grain. I then enter the pea and bean fields, where we are sure to find abundance of depredators. Mangel-wurzel and carrots next occupy my attention; and thence I proceed to examine the potato crops, which afford a wide field for inquiry among the beetles, bugs, &c., which live on their haulm, as well as the larvæ of various beetles, gnats, flies, &c., which injure the tuber itself. I propose finishing my labours by an examination of the insects injurious to clover crops and pasture lands.

In perusing this volume, the reader who wishes to make himself acquainted with the economy both of his insect friends and enemies, whose histories are the subject of the following chapters, ought not to pass over as useless the descriptions of the various species. It is a great mistake to suppose, that scientific descriptions and correct nomenclature ought to be employed for the use of those only who are specially engaged in the study of natural history. If insects be not thus accurately and scientifically described, and their names carefully learned, the facts noticed by practical observers are generally worthless, and may tend to mislead, by the confusion of one species with another, and the consequent adoption of improper remedies. It is thus that I have found, in my extensive reading on these subjects, that a very large amount of the information given by practical agriculturists and gardeners, has proved valueless in cases where, if the particular species alluded to could only have been identified, it would have been of great value in furthering subsequent investigations.

In conclusion, I will mention those works which I regard as the most useful on the subject. Amongst foreign authors, the works of Reaumur and De Geer (when they can be procured) may be safely recommended, as also those of Köllar and Bouché, and the memoirs of Guérin Méneville, Herpin, Bazin, and Asa Fitch. In our own country, Kirby and Spence's *Introduc-*

tion to Entomology, combines truth, instruction, and amusement. Mr. Westwood's contributions in the *Gardener's Chronicle*, and elsewhere, are the result of long experience. I would also direct attention to the papers upon noxious insects in the early volumes of the *Linnean Transactions*, by Markwick, Kirby, and others; although written upwards of half a century ago, they still remain models for the practical agriculturist, from their truth and simplicity, accompanied as they are by data which will always be valuable.

It only remains for me to acknowledge my obligations to the numerous correspondents who favoured we with their observations throughout a long period; amongst others, I cannot refrain from specially offering my best thanks to Professor Henslow; A. H. Haliday, Esq., of Dublin; J. F. Graham, Esq., of Cranford; and a Lady in Surrey, who has transmitted to me valuable researches and careful observations from the commencement of my work on *British Entomology*, to the present time.

LONDON, *January*, 1859.

FARM INSECTS.

CHAPTER I.

THE NATURAL HISTORY AND ECONOMY OF THE DIFFERENT INSECTS AFFECTING THE TURNIP CROP.

UNLESS we collect facts on good authority, and conduct experiments with care and perseverance, our labour will be lost, in studying the economy of the insect tribes; for in the investigation of such living atoms, as they often are, the slightest error may lead us far from the truth. It is not to be expected that a taste for such studies will be universal, though all who can appreciate the value of a good harvest will take, it may be fairly presumed, an interest in our researches. Such a taste, however, where it does exist, is easily improved; and it is a truth admitted by all who have indulged in such pursuits, that they never repented of the time that had been given up to these laudable objects; and, independently of the amusement to be derived from the investigation of nature, any benefits conferred on man by such knowledge ought ever to be a source of real satisfaction, and of honest pride, to every cultivator of natural science, however trifling his contributions may be to the general stock of information.

Unimportant as insects may appear to the casual observer, they often prove awful visitations when employed by the Creator as his armies to fulfil his ends. No one suffers more from these hosts than the agriculturist; it is therefore impossible that he can remain an indifferent spectator whilst it may be in his own power to palliate, if not to avert the evil. I therefore hope that these memoirs, by calling the attention of the farmer to so important a subject, may lead him to useful and profitable results; and should he derive as much advantage from their perusal as I anticipate of pleasure in their detail, it will prove to me a source of unfeigned gratification.

I am aware that one of the greatest difficulties the farmer has to contend with is that invariable law of nature which compels him to change his crops, from the exhaustion of certain elementary parts of the soil, which are absorbed or neutralized by the vegetable that is produced; and with all his art in selecting manure and resting the land, it will become tired at last, and by degrees refuse to produce certain crops nearly altogether: it is even asserted of the turnip, that it certainly does not grow so vigorously nor so readily as it did several years ago. It is natural to suppose that as this period approaches the crops will become, from feebleness, more susceptible of disease; and as insects are intimately connected with this subject—contributing in no small degree to the dissolution of vegetables, and the failure of our crops being frequently very justly attributed to them—this is a matter well deserving of our attention; and in pursuance of this object, we will first consider those insects which attack the turnip, a root of the greatest importance to us all: for without turnips our sheep and cattle would be deprived of one great resource, so that we should be almost unable to procure fresh meat in winter, most essential to the health of man; and the land again would lose that fertility which in feeding off the turnip we secure for the succeeding crops.

No crop is subject to the attacks of a greater number of noxious insects, &c., than the turnip. First, the ants run off with an incredible quantity of the seeds; then come two sorts of turnip-fly, the striped and the brassy, which destroy the tender leaves as soon as they burst from the ground; at the same time we have the maggot of a fly and the wire-worm, both living upon the young roots; and also a large caterpillar or grub, when they are more advanced; then follow armies of black caterpillars, reducing the leaves to skeletons, and the blight of the plant-louse, together with a minute moth; we may add also two weevils, which cause the lumps or excrescences on the bulbs; with slugs, snails, and mildew bringing up the rear.

Before entering upon their history, it will be necessary to make a few observations relative to the economy of insects, which I beg may be borne in mind in the perusal of these memoirs, as they will be of service in the investigations I propose, and in which I hope every practical man will lend me a hand; they will also smooth the road to those who have not a scientific knowledge of insects, and are not skilled in the study of entomology.

Insects have been divided into large masses, named ORDERS; these are subdivided into lesser groups, called FAMILIES, which comprise smaller companies, designated GENERA; and each of these consists of more or fewer SPECIES, or different sorts, which occasionally vary in size and colour, and such are termed VARIETIES. Another still more important fact to be remembered is, that all insects progress through several stages:* first, the female lays an egg; this *egg* hatches and produces, secondly, a *larva*, which is a little animal called a maggot or gentle, a caterpillar or canker, a worm or grub, &c. Thus we have *maggots* in cheese and meat, called gentles by anglers; *caterpillars* on cabbages, *cankers* in roses, *wire-worms* and *silk-worms*, and all sorts of grubs. When any of these have fed until they are full-grown, having been compelled to cast their skins several times as they increase in size, they change, thirdly, to a *pupa*, chrysalis, aurelia, or nymph: they either enter the earth for this purpose, as most naked maggots do, or, like hairy caterpillars, they spin a web, in which they undergo their transformation or change; but the caterpillars of the cabbage-butterfly, and many others, merely suspend themselves to a wall or rail, and there remain unprotected during the winter. In this state they all rest without any symptoms of life,† except when touched, until the substance of the inclosed larva has become perfected into the various members of its first parents, when, fourthly, out comes a flesh-fly, a butterfly, a rose-moth, a click-beetle, a turnip-fly, &c.; and this is called the *imago*, or perfect state.

The turnip-beetle, with whose history we will begin, belongs to the order COLEOPTERA, from its wings, with which it flies, being folded beneath two horny cases. It is included in the family CHRYSOMELIDÆ, or golden beetles, for certain scientific reasons, in conformity with its structure, and is one of about one hundred species forming the genus ALTICA, sometimes written HALTICA.

The ***striped turnip-beetle***, or, as it has been called, the turnip-fly, turnip-flea, earth flea-beetle, black-jack, &c., is named in our catalogues ALTICA NEMORUM.‡ The former word, derived from the Greek, alludes to the leaping powers of the genus, and the latter signifies that this species inhabits woods and groves, which were more especially its haunts before the cultivation of the turnip became general.

The economy of this little pest has puzzled the man of science, as well as the practical agriculturist, for many years; and for want of that rigid care which is indispensable in the investigation of natural history, numerous errors have been adopted, which have led to the promulgation of many false theories. Dr. Pearson believed at first that the white spots or dots observable on more than half the turnip-seeds were the eggs of the turnip-fly; but

* Plant-lice often bring forth young, instead of laying eggs, and so do blue-bottle flies, but not always; and there are a few other exceptions.

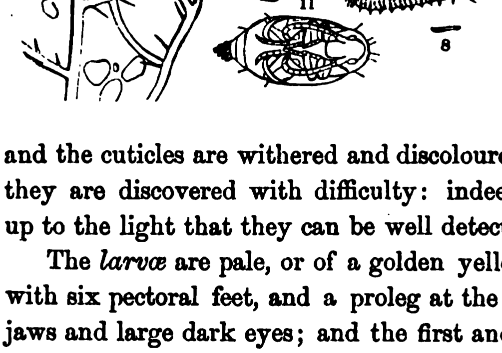
† This law of nature is applicable to most of the tribes of insects here alluded to, but in some orders, as the Hemiptera or bugs, also cockroaches and grasshoppers, the pupæ are not quiescent, as they resemble the perfect state in having the power of locomotion.

‡ See Curtis's *Guide to an Arrangement of British Insects*, second edition, column 74.

he was compelled to abandon that opinion, "having had no flies where the seed was sown in soil contained in pots covered with bell-glasses." "Rusticus," however, a contributor to the *Entomological Magazine,** so strongly insisted upon it, that seeds steeped in brine, or otherwise prepared, have been sold in London at the seed shops, to insure the grower against the attacks of the fly. It is exceedingly likely that the white dots are occasioned by minute flies alighting upon the seeds while they are drying, and depositing their excrement upon them, which is often white; or they may be particles of pollen from the flowers. It was, however, from the careful investigations of Mr. H. Le Keux† that we were first made acquainted with the actual economy of this little beetle.

If the spring be warm the sexes pair from April to September, during which period the *eggs* are deposited by the female on the under side of the rough leaves of the turnips. She lays apparently about one egg daily; and ten pairs laid in a week only forty-three eggs. This indeed was under confinement; but the correctness of this estimate is supported by the fact, that in leaves taken from the field, containing as many as six larvæ, they were all of different sizes, indicating a variety of ages. The eggs are very minute, oval, smooth, and partaking of the colour of the leaf. (See No. 1, figs. 4 and 5; and Plate A, fig. 1.) They are hatched in ten days; and the little maggots immediately begin to eat through the lower skin of the leaf, and to form winding burrows by feeding on the pulp (fig. 7). These burrows are visible enough to the naked eye when the larvæ leave them, and the cuticles are withered and discoloured (fig. 6); but in their early stage they are discovered with difficulty: indeed, it is only by holding the leaf up to the light that they can be well detected.

No. 1.



The *larvæ* are pale, or of a golden yellow colour, fleshy, and cylindrical, with six pectoral feet, and a proleg at the apex: the head is furnished with jaws and large dark eyes; and the first and last segments bear dark patches (fig. 8; 9, magnified; and Plate A, fig. 2): they are full fed in about six days, when they desert their burrows and bury themselves not quite 2 inches

* *Entomological Magazine*, vol. i. p. 363.

† *Transactions of the Entomological Society of London*, vol. ii. p. 24.

below the surface of the earth, selecting a spot near to the bulb, where the turnip-leaves protect them from wet and drought.

In the earth they become immoveable *chrysalides* (fig. 10; 11, magnified; and Plate A, fig. 3), which are brought to maturity, I believe, in about a fortnight, when the beetle or fly, as it is called, emerges from its tomb, again to fulfil the laws of nature.

The *beetles* (fig. 1, magnified; figs. 2 and 3, natural size; and Plate A, figs. 4 and 5) are shining black, minutely punctured; the head is rather small, with two prominent orbicular eyes, finely granulated; the mouth projects a little, the upper lip and feelers being visible: just above the nose are placed two longish horns, each composed of eleven joints, the three next the head ochre-coloured, the first being the longest, the remainder dull black, the terminal one pointed; the thorax, or trunk, is broader than the head, narrowed a little before, with the sides rounded: the two wing-cases are moveable, and form an oval; they are twice as broad as the trunk, and four times as long; each has a distinct ochre-coloured stripe, sometimes approaching to white, running down the centre, generally winding a little on the outside, near the middle, and curved inward at the extremity: beneath are ample wings, twice as long as the body, and folded up for protection when unemployed: the legs are of a rusty ochre, the thighs pitch-coloured, the hinder* (fig. 8, *m*) being very thick and formed for leaping; their tibiæ, or shanks, are also the stoutest and thickly fringed on the outside towards the end (fig. 8, *n*): the feet are all composed of four joints (fig. 8, *o*), the tips as well as those of the shanks generally pitch-coloured; in the hinder pair the basal joint is considerably the longest; the third is formed of two slightly dilated lobes, roughened beneath with fine hairs, as well as the two preceding jŏints, for the sake of adhering to smooth surfaces, and they are thus enabled to ascend glass; the fourth joint is slender and club-shaped, and always furnished with two minute claws.

The mouth is composed of six parts (fig. 7); the upper lip, or *labrum*, is large, broader than long, and a little narrowed before; the anterior margin is slightly concave, and furnished with two short bristles (fig. *e*). The *mandibles*, or teeth, form two sets, one placed on each side, so as to meet; they are strong, bony, and semilunate; one terminated by three, the other by four sharp strong teeth; the second being the longest, the lower one smallest (figs. *f*, *f*). The *maxillæ*, or jaws, are two, placed on each side, beneath the teeth: they are small, terminating in two lobes, densely fringed with fine hairs at the apex; the inner lobe the largest, somewhat orbicular;

* All the following figures and letters refer to the dissections at the foot of Plate A.

the outer one smaller, being an articulated, somewhat ovate lobe (figs. *g, g*): on the outside of each jaw is attached a moderately long and stout feeler or *palpus*, composed of four joints: the basal joint is clavate—the second is obovate and truncated—the third is much stouter and similar in form—the fourth is the longest, stout and conical, being somewhat pear-shaped (figs. *h, h*). The *mentum*, or chin, is somewhat quadrate, the sides are convex, with the anterior angles acuminated (fig. *i*): the *labium*, or under lip, is somewhat quadrate, horny and truncated at the base, with a leathery oval lobe in front (fig. *k*); the sides are excavated to receive another pair of small feelers, or *palpi* (figs. *l, l*): these are very short, stout, and composed of three joints only; the basal joint is cup-shaped and scarcely visible—the second stout and oval—and the third is very slender, with the apex pointed.

The length of the beetles varies from $\frac{3}{4}$ to $1\frac{1}{4}$ of a line; the line being the twelfth part of an inch: the longer ones are the females, which are considerably stouter than the males, and this is especially the case after impregnation.

When the beetle is feeding, the different parts of the mouth are all employed: the upper and under lips open to liberate the other organs; the two sets of teeth, or the toothed mandibles, as they are named, meet when closed, and from their strength and horizontal action, they readily break the cuticle of the leaf. Indeed, some that I put into a quill soon reduced the inside of the cork stopper to powder. The jaws seem to be adapted for keeping in the food during the short process of mastication, and the four feelers hold and steady any portion of the leaf to be eaten, and assist in conducting the detached morsels into the mouth.

From the experiments so successfully conducted by Mr. Le Keux, it appears that the female beetle lays but few eggs compared with most other insects, and that it requires a period of about thirty days to carry the animal through its various stages up to the time when it becomes a perfect beetle again—namely, it remains an egg ten days, a maggot six, and a chrysalis fourteen days: the beetles themselves are rather long-lived, for they have been kept in that state from July until the following February.

The turnip-beetle, and all the species of *Alticæ* related to it, are readily known by the great thickness of their hinder thighs, which gives them the power of leaping, like fleas, to a prodigious distance, considering their small size. Eighteen inches is about the greatest extent of their leap, which in a straight line would be, averaging their stature, 216 times their own length: and when it is remembered that this leap is performed in a curved line, it must be admitted that a considerably greater distance is achieved. They seldom walk, and when at rest, sit with their hind legs folded under them (fig. 6, *c*), ready to skip off in an instant, if disturbed, or when even approached: in warm weather, during sunshine, with the thermometer standing between 70° and 80° in the shade, they fly with facility.

This little plague is not confined to our island, for it is abundant in Germany, and common everywhere in Sweden, where it is very destructive in its perfect state. Probably in England no portion of the country is perfectly free from these insects, at least every bank and meadow harbours them to a greater or less extent, and they have been found also on grass lands which had not been ploughed for many years, and where there were no turnips within half a mile. It will be necessary to consider this part of their history before we enter upon a discussion of the remedies. The turnip-beetles hybernate, or live through the winter in a torpid state, and may be found under the bark of trees, as well as beneath the fallen leaves, in the chinks of old timber and paling, the stumps of thorns and of other bushes, where the bark does not adhere close to the stem, and the hollow stalks of grass and stubble seem to afford them an asylum during the inclement months of winter; but inactive as they then are, the warmth of the hand is sufficient to revive them in a few minutes, so that an unusually mild day in January or March will partially seduce them from their retreats, and will render them almost as active as would the ardent sun of summer.

On the first indication of spring, if the weather prove fine, warmed by the sun and cheered by his rays, they arouse from their slumbers, and permanently leave their winter-quarters for sunny situations, where they may be seen sitting on walls in considerable numbers, or sunning themselves on dry banks and on clods of earth, protected from the wind; they have been observed in gardens on turnips and cabbage-plants as early as March, and in April on the crops in the fields; but May and June appear to be the more usual periods of their first and most fatal attacks. The autumnal crops have been occasionally destroyed by them,* and in one instance I have seen their destructive operations recorded as late as the middle of September. They may be said to be abundant from May to October amongst the grass, and in all fields, whether of wheat, oats, or barley; a friend of mine observed myriads on turnips in Surrey, on the 2d of September, but they all disappeared in two or three days; and both sexes were common on the white turnips in Dorsetshire in October, 1840.

It seems that the taste of the turnip-beetle is far less fastidious than is generally imagined. This might be fairly inferred from its abounding in situations where the turnip does not grow; there can be little doubt,

* In 1826 a crop was destroyed at Knutsford after the 21st of August.

however, that it prefers those plants which are termed cruciferous, from the shape of their flowers, of which cabbages and turnips are examples; of these the leaves of the horse-radish, the common turnip, and the radish are its favourite food, but cabbages, cauliflowers, colewort, water-cresses, ladies'-smocks, and hedge-mustard, called jack-by-the-hedge, are often attacked; the charlock or wild mustard is also sometimes covered with them at the end of April, and in May the leaves will be seen pierced with holes, but as soon as the turnips come up they desert other allied plants. Mr. Berry has recorded a remarkable exception, for he says that after consuming the cabbage-plants, the flies * attacked and destroyed the young hops, which belong to a very different tribe of plants. Köllar also states that both summer and winter turnips left for seed suffer in warm and dry weather, from the attacks of the fly injuring the flowers, so as to spoil the produce of the seed.

The next subject to be considered is a remedy against the attacks of the turnip-beetle, which in some years must cause losses amounting to an enormous sum of money, for so long back as 1786 Mr. Young stated that the turnip crop destroyed in Devonshire alone was valued at £100,000. Now with regard to the *eggs*, we see that they are laid on the *under side* of the *rough leaf*, where they are pretty well secured from rain, and also protected by the strong and projecting ribs that support the leaf from any injury that might occur from the leaves being ruffled by the wind or other casualties; and the inferior skin being the most delicate, is best adapted for the entry of the infant and tender maggots into the substance of the leaf. It is not, therefore, at this stage that much could be done in destroying them.

The *maggots*, it is evident, live upon the *rough leaf*, and do little or no mischief to the growth of the plants; they dwell perfectly secure between the two cuticles, unless it be when they leave the burrows they had first commenced—probably not of common occurrence—to form new ones at a remote part of the same or upon another leaf. At this period they are most probably affected by parasitic enemies.

The *chrysalis* is buried only just beneath the surface of the earth, but it is probably protected in a slight web, forming a cradle for it to lie in free from pressure. I think some efforts might be successfully made for its destruction at this time.

It is, however, in its last and perfect state that the mischief is done. It is the *beetle* which destroys the two first *smooth leaves*, called the *cotyledons*, and the heart of the plant between them, by piercing them like a sieve,

* Might not these have been the *Altica concinna*, or some allied species?

destroying the cellular tissue, and stopping the growth of the plant. They also feed upon the rough leaves, drilling them full of round holes (fig. *d*), which are larger on the upper than the under side of the leaf; and if the appetite of the beetle be not satisfied, he enlarges the aperture, and thus gives it an irregular form, which dilates with the growth of the leaf: hence the large holes we see at a later period. After all, it is at this stage of their existence, I am inclined to believe, that we can attack them with the best prospect of success, if they cannot be kept off by other means.

In collecting the turnip-beetles by sweeping and various methods, large numbers of small carnivorous beetles, belonging to the *Carabidæ* and *Staphylinidæ*,* are found with them; these probably feed upon the larvæ; but, from the very recent discovery of the early stages of the turnip-beetle, we are yet ignorant of the *parasites*, of which it may be presumed there are more than one species, that prey upon the maggots and chrysalides; for it is a wise dispensation of Providence to keep every animal in check by some other that is either more powerful or more sagacious than itself; and this counteracting effect is produced in a degree equal, or eventually superior to the noxious animal, so that in a greater or less space of time the destructive power may be rendered no longer formidable, or be absolutely annihilated by the attacks of its parasites. This natural process, though never failing, is often too slow in its operation to secure immediate relief; the farmer must, therefore, devise means, if possible, for the more speedy destruction of the enemy.

The beetles are seldom found in shady places, except during the winter season, and they cannot bear cold and wet, which are great protections against their increase; it consequently follows that warmth and sunshine are far more favourable to their multiplication, and in such seasons they are most to be dreaded. Showery weather, after a long drought, and cloudy days with gleams of sunshine, also render them abundant,† as such seasons do the greater portion of insects; but in a few instances they have been known to do much mischief even in cold weather.

That the turnip-beetle is endowed with an acute and powerful sense of smelling, is proved by his flying against the wind, and deserting all other plants as soon as a turnip crop appears in his neighbourhood. Mr. Le Keux says, that in May, 1836, when the thermometer was at 75° in the shade, during a *south wind*, great numbers were on the wing, and all proceeding *southward;* and again, that eight acres, forming the summit of a hill in

* Curtis's *British Entomology*, fols. 446, 758, &c.

† A field of turnips is stated to have been destroyed by the fly in a few hours before a thunder-storm at Rockingham.

Devonshire, were sown with turnips, and when the young plants were just rising above the ground, the wind being for more than a week at south-east, wafting the scent to the north-west, they were so destroyed on this side, that nearly an acre was bare, whilst the south-east side was not touched, until the plants had attained a size to render the attacks of the beetle of little consequence.

From what has been stated, it appears that no season will secure us entirely against the attacks of the turnip-beetle, and that no soil is considered safe from them is evident upon the best testimony; it is very destructive upon strong lands, and not less so on light ones. Neither is the period of their attack limited, for as one pair of insects may produce five or six broods in a season, there is a constant succession, which renders any plan for extirpating the beetle in any of its three early stages scarcely practicable. As the turnip when in rough leaf is not in any danger from the attacks of the beetle, it is evident that our first care must be to preserve the young plant, and this can only be done by the preparation of the soil, or using such speedy means the instant the beetles appear, as will destroy or drive them away. The primary object will be to discover the best manure for that purpose, and a dressing that will render, if possible, the soil obnoxious to the insect.

It has been correctly said, "that the manure which most effectually promotes the growth of the plant will be the best defence from the insect; and that when the growth is slowest, the danger from the insect is most serious." This arises in a great measure from the advantage that insects have over vegetation; a gleam of sunshine is almost sufficient to call them into active life, as we have before observed, and as is evident from the swarms of delicate gnats that may often be seen dancing in the air when frost is on the ground even in January; but it requires the accumulated rays of the sun, and a much longer duration of warmth, to set in action the fluids of plants.

It will not be irrelevant to the subject to take a cursory view of the recommendations suggested by various eminent agriculturists; and as the results derived from some of their experiments have been greatly at variance, I may venture occasionally to offer an opinion; but as it is not strictly within my province to *determine* such practical points of difference, I can only hope that they may be encouraged to prosecute their valuable researches until such variations are satisfactorily explained.

Whether any *direct* protection against the beetle can be expected from manure, since it is ascertained that it is not upon the seeds that the eggs are laid, now becomes a question; for when the maggots escape from their burrows in the leaves, and enter the earth, in order to become chrysalides, before changing to beetles, the manure, I should think, seldom contains sufficient ammonia to destroy them, and, if I mistake not, any moderate fermentation would rather facilitate than retard their metamorphoses; moreover, the instinct of insects is so perfect, that the maggot would most assuredly avoid obnoxious spots, so that, if any manure were spread that would injure them, unless it formed a very uniform stratum, it would not insure success, although great advantages might be derived from its use.

Burning has been found the best preventive against the beetle by some, which is readily accounted for, since it would destroy any chrysalides in the land; and as the beetles may be in abundance in the field when it is preparing for turnips, burning would, of course, be destruction to them, and spreading the ashes afterwards over the ground will prove an additional security; but such a system does not suit sandy soils, neither can it be followed up regularly on any land.

Feeding off the turnips is strongly recommended as an antidote to the beetle, as well as from its peculiar advantages of manuring and preparing the land for the barley crop and succeeding seeds. I am disposed to attribute the advantages derived from sheepfolding, as regards the beetle, to the perfect stamping down of the soil and herbage, by which all insect life is destroyed, rather than to any peculiar quality in sheep-manure, unless it be contained in their urine.

However Mr. Sutton's "plan of preparing the fallows for the seed, and leaving the land for ten days or a fortnight before sowing," may have answered occasionally, as his hypothesis is not correct, we must look to other causes for his success, and this is probably the exposure of the chrysalides to drought and changes of temperature, which would naturally destroy them; the opportunity the weeds have of growing up and overpowering the crop seems to be a fatal objection to this process. I quite coincide, however, with Mr. Cowdry, that the destruction of the beetle may be greatly facilitated by the mode of ploughing he suggests, for if the chrysalides be deeply buried under the furrow, they will perish for want of sufficient sun and moisture to bring forth the little beetles, or even if they hatched, they would not be able to extricate themselves from the earth heaped upon them; this is taking it for granted that the chrysalides are in the soil, which would depend upon the character of the preceding crop. And here again we require information; for if the maggot of the turnip-beetle will live in the leaves of clover and other artificial grasses, then such a process as deep ploughing becomes an effective remedy; if not, it would only be useful where the first crop had failed, from the land being infested with the turnip-beetles.

If the turnip-beetle were not common everywhere in Sweden, it might be presumed that northern latitudes were uncongenial to its habits, for it did not appear to be known in Scotland until 1826, and it has done but little mischief, I believe, since; but this is attributed, by Dr. Fleming and others, to the turnips being drilled in; indeed, broadcast is generally considered inferior to drilling, and the system of ridging for the drill is recommended by most farmers. Cold and wet, we know, do not agree with the perfect insect, and such seasons may be still more pernicious to it in its earlier states, which may account for its rarity in Scotland, where I do not remember to have noticed it, and in parts of Forfarshire and in East Lothian the fly is said to be scarcely known. Mr. Bowie, however, of Arbroath, seems to be well acquainted with the effects of the fly, although he only remembered its attacking the plants once in rough leaf, and that was during the hot and dry summer of 1826. I see also that at Cramond, near Edinburgh, it is now (1841) abundant. No notice has been taken of it in Scotland, except on the eastern side, where it may be expected, as in the eastern counties of England, that the fly would be most fatal to the crops, as there is a much less fall of rain on that side than in the western and south-western quarters of the kingdom; we see, however, from the destruction recorded in Devonshire, that in a warm district, although subject to a great deal of wet, its progress is not always impeded.

It is the opinion of a great many agriculturists, that raw and long manure harbours the beetle, and if turnips be sown on a stubble-crop, they are often completely destroyed. I see Mr. Webb Hall states that he has had to sow stubble-crops three times over, and seed sown on stubble late in August has been taken off by the beetle in more than one instance. Whether this arises from the hollow straws affording a retreat for the beetles, or that the weeds had supported them or the maggots, so that the chrysalides were lying undisturbed in the land, is not easily explained.

Mr. Linton, and many others, recommend drilling-in, not less than 3 or even 4 lbs. of seed to the acre, and 6 or 7 lbs. broadcast;* for he very justly observes, that thick sowing causes the plants to grow much more rapidly when young than thin sowing; and by drilling-in with the seed a peculiar compost, containing the strongest animal manures, the fly, he says, has never yet disappointed him of obtaining a good crop.† I think it probable that the ammonia in this potent manure may be disagreeable, if not destructive, to the insect; and the rapid growth of the plant, from its stimulating effects, defies their attacks. The vegetation of the seed may be accelerated by steeping it in water for twenty-four hours; and the surest way to obtain a strong crop is to sow seed of the same age, otherwise the plants do not come

* I apprehend this thick sowing would produce a very weak plant.

† *Journal of Royal Agricultural Society*, vol. i. p. 452.

up simultaneously, and the fly will attack and destroy the crop in detail; for it is ascertained that young seed vegetates quicker than old, this year's seed will therefore have the start of two or three years' old by as many weeks.

Mr. Linton also adds, that he has found more benefit from the manure he describes in the succeeding crops of clover-seeds, than from 3 or 4 chaldrons of lime to the acre. With regard to the use of lime, a great deal must depend upon the soil on which it is used, which may account for the conflicting opinions respecting its effects in protecting the turnips against the fly. From 6 to 8 bushels of quicklime per acre may be sown over the young plants successfully in dry weather; but it must be repeated after rain or dew; and this, as well as soot, requires to be regularly and evenly dusted over the plants. Mr. Birk says that he used slaked lime with perfect success; and, although profusely, it did not at all injure the plants. It should be slaked at the time of use, and ought to be spread in the very hot state, when it burns the fly. Some danger to the plant seems to attend this process, arising from the heat generated by the lime—at least so I presume; but some little explanation is required in these statements to distinguish clearly between slaked and quick or unslaked lime. Very different were the results from Mr. Le Keux's experiments. Forty bushels of lime per acre were spread, he says, immediately before the seeds were sown, and did no good; and when the plants came up, and the fly was observed attacking them, lime-dust was thrown over them, so that many of the plants were quite white with a coat of it; after which as many flies were found upon those as upon any that were free, and they were eventually devoured. This is again quite at variance with the opinion, that repeated dustings of ashes and soot, when the plants are wet with dew, will keep off the fly, and prevent their feeding.* In another place he states, that the upper part of a field in a sheltered situation, with a south aspect, which had been sown with barley, was well dressed with lime, and sown early in May with whitestone turnips, which were destroyed as soon as they appeared above ground; the land was sown again, and harrowed, the surface being thickly strewed over with wood-ashes; the plants were, however, devoured as rapidly as before.

The growth of the turnips being stunted by too frequent repetitions, they become fingery on light sandy soils, and are then more likely to fall a sacrifice to the fly. A good coat of clay or chalk has the effect in Norfolk and Suffolk of invigorating the land, and giving it the power of again producing good crops once in four years. The culture of mangel-wurzel is well deserving the attention of the farmer, when the land gets tired of turnips;

* It is contrary, also, to my own experience; for a plot nearly eaten off by them, recovered on being well dusted with lime.

and it has the additional recommendation of not encouraging the increase of the turnip-beetles. As it is quite certain, I should say, that the beetles are attracted by scent, it appears to me likely that, if a field of turnips were planted round with a belt of mangel-wurzel, the turnips might escape their attacks, if not entirely, to a very considerable extent; especially when the insects are believed to come from a distance; for at the early stage of the plants a few hours of respite may be of vital importance. The Swedish turnip, or *Ruta-baga*, whether it be a hybrid produced by the turnip and cabbage, or a distinct species, has not the strong scent at an advanced period which is so perceptible in the English turnip when in rough leaf; and if there be as marked a difference of smell in the seed-leaves, it would give the former a decided advantage in exposed situations, where the beetles are attracted from distant localities: being sown in May or June, however, is, I conceive, not a recommendation, as I believe that to be a period of the year when the first principal brood is generally at its maximum, as the second is in August or September; but the temperature of the seasons may in this respect make a variation of a fortnight or three weeks on either side of the average: however this may be, it is admitted on all sides that the beetle is weakest in July.

I fear, on the other hand, that no early sowing can insure the turnip-crop; for as the beetles hybernate, the same warmth and sunshine that make the seed vegetate will bring the swarms of beetles from their retreats; and it is worth considering whether by early sowing we do not entice a hungry horde from their winter-quarters, or from the banks and meadows where they are at first supported; whereas by not sowing until midsummer, the beetles may in the meanwhile be starved and drawn off to more favourable localities, or have fallen a sacrifice to small birds, and the casualties of the wet and cold of our spring. Such seasons we know do not agree with the beetles; and I have observed that when the dew is upon the turnips in the autumn, they keep under the leaves, and appear to be asleep; and windy weather has a similar effect in rendering them quiescent. The crops being attacked and destroyed in the autumn, does not altogether militate against good success at midsummer, especially in forward seasons. Similar objections to the above may be urged against sowing the white turnips with the Swedes; for if the quantity of beetles be small, the Swedes may be preserved in consequence of the English turnip being their favourite food; but, on the other hand, multitudes may sometimes be thus attracted from a distance, which would not otherwise, it may be presumed, have detected the Swedes, from their scent being less perceptible.

It is twenty years since I intimated that "some benefit might be derived from destroying those cruciferous plants, *Erysimum alliaria* and *Cardamine pratensis*,* to which these *Alticæ* are so strongly attached, for they grow in abundance in every hedge and meadow; they appear long before the turnips come up, and attract and give support to the parents of the future swarms that are to sweep away the crops of the farmer."† As these plants often flower at the beginning of April, and produce their leaves at a much earlier period, it is almost certain that they nurse the fly, and are its great resources for food and nourishment in the earliest days of spring; but how to eradicate the *Cardamine* is for future consideration.‡ The hedge-mustard, and other cruciferous plants on banks and road-sides, are quite under our control; and it is a duty which we owe to our neighbour as well as to ourselves, to keep our fields and hedges clear of charlock and every allied weed of that family, all of which harbour the turnip-beetle.

Before dismissing this portion of the subject, two or three remarks will be useful. It is certain that manure gives strength to the turnip plant, but it is doubtful if it will destroy the beetles. Hoeing and rolling may harass and kill many of them; and as this process promotes the more rapid growth of the plants, it must be attended with no slight advantages. I expect also that if it were performed in damp days, or after heavy dews, the benefit would be increased; for if the beetles leap in moist weather, they often fall upon their backs, where they stick, and, after being exhausted, become torpid and apparently dead, if the air be cold; but they reanimate as they are dried by the sun. In cold and wet weather it might not prove less efficient; for multitudes of the flies are then sheltered under and about the clods, which being broken down, the insects must perish by the pressure; and if there were any chrysalides in the earth, they would in all probability suffer the same fate.

There are many who consider that turnips should be sown immediately after ploughing, and that much of the success attending a crop depends upon the diligence employed in getting in the manure and seed; whilst some maintain that the land should lie undisturbed for a fortnight before sowing. Such conflicting opinions, as far as the fly is concerned, may often be reconciled by the difference of the seasons when the observations were made.§ We know that turnips must not be sown in too dry nor too wet a state of

* Curtis's *British Entomology*, Plates 569 and 179, called sauce-alone, or hedge-mustard, and common ladies'-smock.

† Ibid., fol. 630.

‡ As this plant luxuriates in moist pastures, draining, probably, would eradicate it.

§ The perusal of the Report in the *Transactions of the Doncaster Agricultural Society* is strongly recommended; and in their "Analysis of the Returns," the date of every year is alone wanting to make it invaluable.

the soil, yet this is precisely the state most fitted for the production of the fly; for it is well ascertained that a moderate degree of moisture is necessary to bring forth or to hatch almost all insects, and if this be accompanied by a mild air, it is the better suited to them; it is therefore reasonable to expect that after a fine early spring the turnip-beetles will be found most abundant.

From the dislike the fly has to repeated wet, I have always thought that watering the turnips would be highly useful; and this opinion is supported by Mr. Bayldon, who recommends them to be watered every other day, four, five, and six times, if necessary.* Irrigating the land would not have so good an effect, I think, as watering, because the beetles would only be floated off the leaves, if they were detached at all; and if they were left thus for two or three days, there would be a great chance of their recovering when the plants were left dry, whereas by the watering they would be forcibly brushed off, and get set fast in the earth and die. The benefit would be most felt, I conceive, on heavy lands, with regard to the annihilation of the beetles; but it would everywhere have the advantage of destroying the chrysalis, by stopping up the pores of the soil, and so preventing the exit of the fly.

Nitrate of soda has been tried in two instances on crops of Swedish turnips with very beneficial effects; and it probably assists, from its peculiar qualities, in checking the increase of the beetles. The nitrate was sown two or three days after the seed; and it may be used on all soils excepting on chalk. It should be sown broadcast, mixed with wood-ashes, which enable the sower to spread it more regularly.

We now come to what may be termed direct remedies.

The Paul-net, as it is called, after its inventor, although it has been considered as a toy, yet I am of opinion might be usefully employed; for I have seen a quart bottle filled with the little turnip-beetles that were all caught with this net. If I remember correctly, Mr. Paul's plan was to sow a small spot with white turnips early, as a decoy, and over that space to draw his net.† It always struck me that vast quantities made their escape by skipping out of the net, which was its greatest defect; but this might be remedied by placing some sawdust at the extremity of the bag, mixed with lumps of common ammonia, or sprinkled with spirits of turpentine, which perhaps would be better; but either of these would kill a great many, and stupify

* How is this to be done? In a garden it might probably have a good effect—but on a score of acres? If, indeed, a water-cart filled with brine could be conveniently once run over a field, it might, as there stated, prove a partial remedy, and it certainly is worth trying; for even should it not be effectual on that point, it would, no doubt, prove beneficial to the growth of the crop.—*F. Burke.*

† A very good representation of this net will be seen in Kirby and Spence's *Introduction to Entomology*, Plate XXIV. fig. 3.

the remainder, until the contents of the net were subjected to sufficient heat to deprive them of life. This process is no doubt troublesome, and requires to be repeated; and unless, perhaps, some alterations were made, it would not answer on an extensive scale. This, however, is no fatal objection to the principle.

A board newly painted or tarred, and drawn over the turnips, will catch multitudes of the beetles; for on being disturbed they leap against it, and cannot release themselves. I should recommend white paint; and the brighter it is the better, as all insects are attracted by light colours. Neither wet nor windy weather would be suited to these operations, for it is ascertained that the beetles are at such seasons disinclined to move; neither would mid-day in fine weather do, as they are then active, and fly well; for it is a well-known fact, corroborated also by the flight of swallows, that in hot days and sunshine insects fly high, whilst in damp weather they keep upon or near the ground.

Fumigation by burning stubble, weeds, &c., to windward of the field, so that the smoke drives along the ground, has proved effectual; but I should prefer burning to leeward as a preventive, for as the beetles are attracted by the scent of the turnips, and fly towards the wind, they would be baffled by such a manœuvre.

Watering the plants with brine sufficiently strong to affect the insects, but not strong enough to injure the young plants, would, I expect, prove a most successful remedy; and when in rough leaf it would also kill the larvæ, and even destroy the eggs that were exposed to its influence.

In Hanover fields of white turnips have been preserved from the fly by thickly sprinkling the *dust of chalky roads* on the young plants at night, when a heavy dew is falling, until they appeared covered with the powder. The fly, it is said, will at once disappear, especially if the next day be a bright sunshine, and the dust is dried upon the leaves, which prevents their little teeth from gnawing the leaf, or disgusts them in some other way, and they depart to more agreeable quarters. If the sprinkling be immediately succeeded by heavy rains, so that the dust is washed off, the operation must be repeated.

We learn that "Mr. Dickson has perfectly succeeded in saving his crop by a very simple dressing. He took some road-dust, some soot, and a little guano, and mixing these together, sowed them along the rows in the middle of the day. In a short time he found that the crowds of flies had altogether disappeared. Mr. Fisher Hobbs has long used a mixture of a similar sort, only he employs a little sulphur instead of guano, and thinks it better to apply it in the night season, when dew has fallen, than in the day-time."

Several other means are suggested by M. Wundram, which have proved to be useless in this country; and his reasoning induces a belief that he is not well acquainted with the habits of the turnip-fly. An infusion of wormwood sprinkled over the young plants and seed-beds will, he says, secure them from the attacks of the flies, as they dislike the bitterness thus conveyed.

Drawing boughs of the elder over the field is supposed to annoy the beetles, and drive them away; and the leaves of the alder, when fresh gathered, being covered with a glutinous liquor, and those of the lime, &c., when the honey-dew is upon them, are recommended to be strewed in gardens for the purpose of catching the turnip-beetles.

I confess that I have no faith in the plants being rendered obnoxious to the fly from steeping the seeds in oil, brine, brimstone, or milk, as practised by many. Such immersions may render the plants stronger, or cause more of the seeds to vegetate, which will at once account for the success that is said to be derived from this process. If, indeed, the eggs of the insect were laid upon the seed, the oil and brine would be most efficacious; but that notion is exploded.

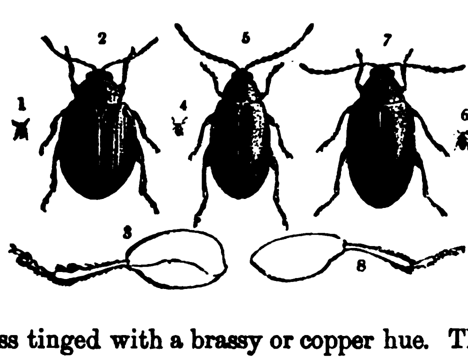
Mr. Le Keux says that washing over the plants with sulphate of potash had no effect; and he very justly observes, that if the upper surface of the leaf could be poisoned, the *beetles* might feed upon the under side with impunity. Powdered sulphur, strewed $\frac{1}{10}$th of an inch thick, did not deter the flies from attacking the plants, but it improved their appearance. Snuff, asafœtida, a powder called *anti-tinea*, for preserving furs, proved equally powerless. They did retire from smelling-salts (carbonate of ammonia), and died immediately on being exposed to the effluvia from it; but a small bit placed an inch from the plant would destroy it also. This, or something that would overpower the scent of the turnips, might perhaps be advantageously employed in driving away or deceiving the fly. One oz. of tar, 1 oz. of olive oil, and 2 oz. of strong caustic potash, well mixed together, and shaken up with the requisite quantity of water, were next poured, the fourth day after sowing, over a patch on a hill swarming with the fly, at the end of August. Not many of the seeds came up, but the few plants from them were of a healthy colour, and acquired the rough leaf; a few only on the windward side being punctured; but several days' rain occurred at the most critical time, which might be their best protection.

Such are the remedies proposed; but I fear it is not by the experiments of a few philosophic men that we can hope to discover any positive antidote to so great an evil. We want correct data from every sort of soil under the various influences of climate and effects of cultivation, before we can fairly grasp the subject. Until we became acquainted with the *economy* of the beetle we were groping in the dark. That important discovery has brought us a few steps towards the light; and those who wish to follow in the path of truth should try and examine Mr. Le Keux's experiments, which it is easy to do, by filling a garden-pot with earth, carefully sifted to take out all worms, centipedes, or other living animals, which might destroy the chrysalides. When this is done, plant in it a small turnip, in rough leaf, having a fine wire-gauze guard, large enough to inclose the plant, and fitting just inside the top of the pot. One or more pairs of the beetles must be placed, with a fresh turnip leaf, in a large-mouthed transparent bottle, then tie over the end a piece of muslin, to prevent the escape of the insects; for if the cork or stopper be put in, the bottle will become wet inside, which will prevent the females from laying any eggs. I imagine they will not adhere to the damp leaf. The leaf may be examined daily through a magnifying glass, and as soon as any eggs are discovered they may be placed in the pot where the turnip is growing, that the little maggots may be able to get at the living leaves as soon as they hatch. The progress of the insect may thus be traced through its different stages; and it will only be necessary to place the garden-pot in a saucer, into which water should be daily poured, if necessary, to nourish and refresh the plant.

Let us not forget that amongst our best friends are the small birds; a great number of which, such as the gray and yellow wagtails, no doubt destroy incredible numbers of these insects in their various stages. Their nests ought to be protected, and the birds themselves defended from persecution.

There is another species of *Altica*, whose habits are similar to those of *Altica nemorum*, which materially assists in injuring the turnip crops. The habits of the brassy or tooth-legged turnip-beetle are not known, but may be expected to resemble those of the striped turnip-fly. I will now describe this insect, the *Altica concinna*, which is the same as the *Altica dentipes* of foreign authors (No. 2, fig. 1, male; fig. 2, magnified; and Plate A, fig. 9).

No. 2.



It is more oval, convex, and shining than *Altica nemorum*, of a greenish-black colour, more or less tinged with a brassy or copper hue. The horns are only half as long as the body, and thickest towards the extremity, of a pitchy colour, with a few rust-coloured joints next the head: the trunk or thorax is thickly but very finely punctured: the wing-cases are scarcely twice as broad as the trunk, but three times as long, having ten lines of strongly-impressed dots down each. The wings are ample; the legs are black, the shanks or tibiæ are bright rust-colour at the base; the hinder thighs are very stout (No. 2, fig. 3; and Plate A, fig. 10, *m*); the intermediate and hinder shanks are armed outside with a short acute tooth, below the middle,* and fringed with hairs and toothed with spines (fig. *n*); the feet are dusky, with four joints (fig. *o*), similar to those of *A. nemorum*. Length from ¾ to 1 line.

It infests hop gardens, and also inhabits hedges, nettles, grass and turnip fields; and is abundant throughout England and the south of Scotland in the spring and summer.

There are likewise two other little beetles of the same genus, far from uncommon upon the turnips. The one named *Altica consobrina* is elliptical, depressed and black, but dark blue and punctured above (No. 2, fig. 4, the male; fig. 5, the same magnified); the horns are tolerably long, with the fourth and fifth joints thickened in the male; it has ample wings beneath the wing cases; the hinder thighs are stout, and formed for leaping. This little beetle assists in the destruction of the turnip, it is believed, by eating the leaves. The other, named *Altica obscurella*, is very similar to *A. consobrina*, but it is generally larger, of a brighter blue above, and the second and third joints of the horns are bright ochreous in the female (No. 2, fig. 6; 7, magnified); the hinder shanks are simple (fig. 8, a hind-leg). This species is sometimes more abundant in gardens than *A. nemorum*.

In the investigation of this subject I have thought it necessary to consider every bearing that connects the beetle or fly with the turnip-crop, that neither its habits nor any circumstance affecting its economy might be overlooked; but in treating of the other insects I shall not have such a variety of materials to digest, which will allow me to render their history more concise. I am now induced to recapitulate the leading features contained in the foregoing account, that they may be brought at one view before the reader.

There are at least two species of turnip-flies or beetles, the *striped* and the *brassy*.

The transformations of the latter are not known.

The *eggs* of the former are laid upon the under side of the rough leaf, from April to September: they hatch in ten, and even in seven days, I believe.

The *maggots* live between the two skins or cuticles of the rough leaf, and arrive at maturity in six days.

* From this circumstance it has been recently named *Chætocnema concinna*.

The *chrysalis* is buried just beneath the surface of the earth, where it remains about a fortnight.

The *beetles* live through the winter in a torpid state, and revive in the spring, when they destroy the two first leaves, called the cotyledons, or seed leaves.

There are five or six *broods* in a season.

These insects are most to be feared in fine seasons.

Heavy rains, cold springs, and long droughts, destroy them.

Their *scent* is very perfect: the beetles fly against the wind, and are attracted from a distance.

To extirpate them during the first three stages is apparently most difficult.

The beetles are sheltered in hedges, banks, under bark of trees, &c.

Their *parasites* have not yet been discovered.

First appearance of the beetles to be punctually observed, as affording the best chance in applying remedies.

Manure to render soil obnoxious to the insects scarcely to be expected.

Rapid growth of the plant the best security.

To secure which *sow plenty of seed*, and of the same age.

Burning beneficial, by destroying the chrysalides.

Sheep-folding must destroy the insects in every state.

Deep-ploughing excellent when the chrysalides are in the soil.

Drilling far superior to broad cast, and believed in Scotland to keep away the beetles.

Dangerous to sow on a *stubble-crop;* and *long raw manure* harbours the beetles.

Lime and *soot*, the benefit derived from them in this way very doubtful.

Mangel-wurzel not favourable to the beetles; and *Swedes* probably less attractive than white turnips.

Mixing white turnips with Swedes not desirable, as the beetles may be attracted by the strong scent of the former.

Early sowing attended with disadvantages.

Destroy charlock, and all cruciferous weeds in fields and hedges, as they afford support to the beetles before the turnips come up.

Hoeing and *rolling* harass and destroy the beetles.

Watering the crops, especially with weak brine, beneficial.

Paul net and *painted boards* useful in destroying the beetles.

Fumigation, by burning stubble, &c., will keep off the beetles.

There are many other remedies proposed, some of which it might be well worth trying; and if we be defeated in our endeavours to vanquish this insect enemy, we must take the field again with fresh vigour until our efforts are crowned with success, and neither despair from disappointments nor rest in listless security from the apparent inertness of our foes. If we look back for one instant to experience, we shall find that after violent attacks of disease in the animal, or of blights in the vegetable kingdoms, they are generally succeeded by a respite of many years, which throws us so much off our guard, that when they return we are not prepared with any proper remedies, and not unfrequently they are altogether forgotten; thus, after a lengthened interval of tranquillity, when we think the hordes of hostile insects have departed for ever, they suddenly make their appearance, and take us by surprise and at advantage. The intelligent farmer must therefore be up and stirring, to detect the first breath of infection, and be instantly prepared with his remedy.

Explanation of Plate A.

Fig. 1. The egg of the striped turnip-beetle or fly, *Altica nemorum*.
Fig. 2. The larva or caterpillar.
Fig. 3. The pupa or chrysalis.
Fig. 4. The beetle or fly represented walking.
Fig. 5. The same flying.
Fig. 6. A turnip-leaf:
- *a*, The burrows formed by the caterpillars.
- *b*, A male beetle feeding, of its natural size.
- *c*, A female beetle at rest.
- *d*, Holes recently eaten by the beetles.

Fig. 7. Six organs of the mouth:
- *e*, The labrum or upper-lip.
- *f*, The two-toothed mandibles.
- *g*, The two maxillæ or jaws.
- *h*, Their palpi or feelers.
- *i*, The mentum or chin.
- *k*, The labium or under-lip.
- *l*, The labial palpi or feelers.

Fig. 8. A hind-leg:
- *m*, The thigh.
- *n*, The tibia or shank.
- *o*, The tarsus or foot.

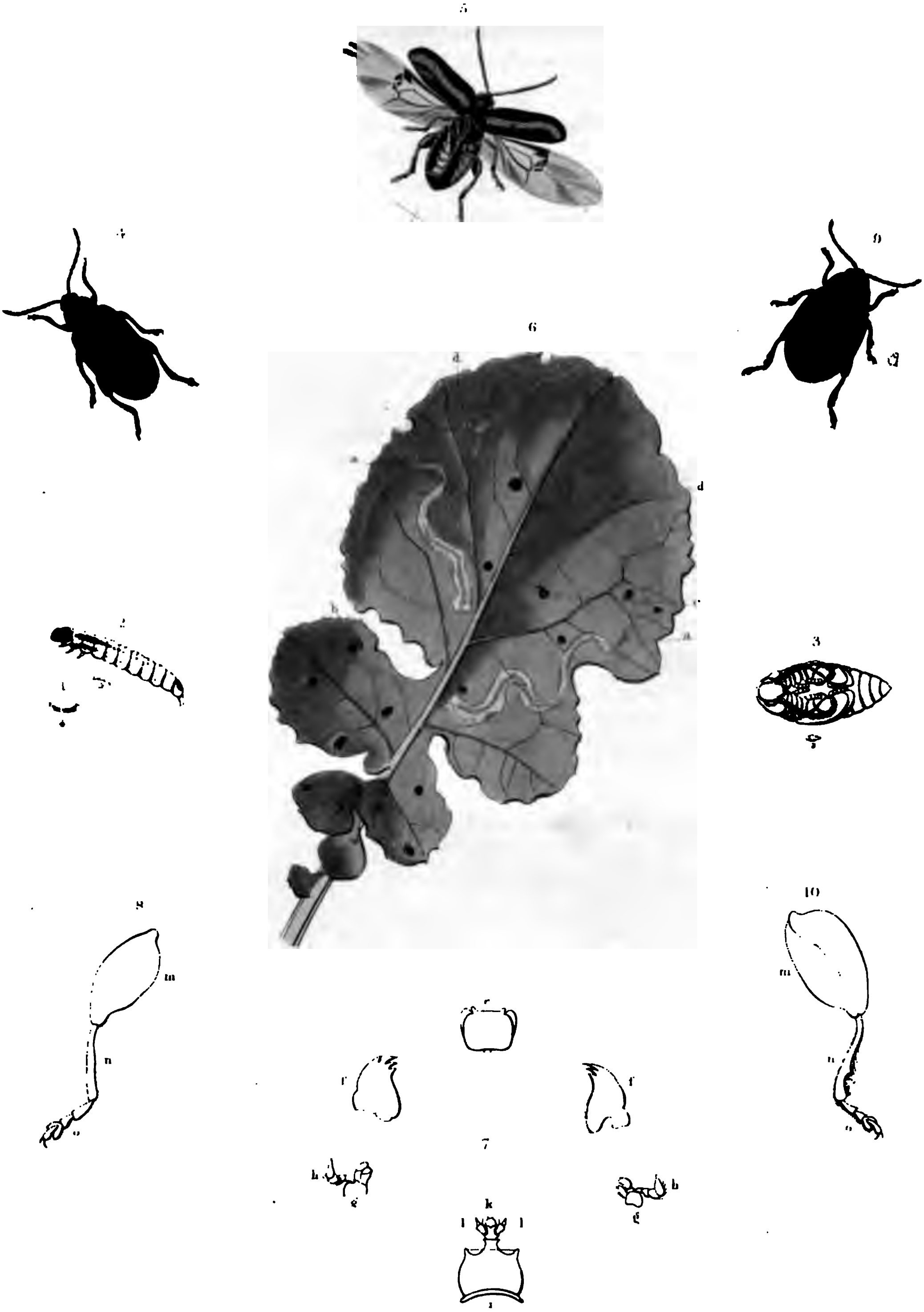
Fig. 9. *Altica concinna*, the brassy or tooth-legged turnip-beetle: the smaller figure shows the natural size.
Fig. 10. A hind-leg of the same:
- *m*, The thigh.
- *n*, The tibia or shank, with the tooth and spines.
- *o*, The tarsus or foot.

All the figures are highly magnified, excepting those upon the leaf, and they are all drawn from nature; but Nos. 1, 2, and 3 were furnished by a friend; their natural sizes are given beneath each object, and marked with an *; the line and crossed lines also added to figures 4 and 5, give the length and breadth of the living insects.

PLATE A

TURNIP CROPS.

Two species of Skipping Beetles called Turnip Flies or Turnip Fleas



CHAPTER II.

THE NATURAL HISTORY AND ECONOMY OF THE TURNIP SAW-FLY, AND ITS BLACK CATERPILLAR, CALLED THE BLACK PALMER, BLACK CANKER, BLACK JACK, BLACK SLUG, AND NIGGER OR NEGRO.

IN studying the economy of insects, the striking irregularity in their appearance is not one of the least curious and remarkable facts that presents itself. We know from observation that what has up to a certain period been an unnoticed or unknown species of insect suddenly becomes abundant, and then disappears as unexpectedly.* This will render it necessary to give the history and details of all such as have at any period proved injurious to the crops of Great Britain. It is deeply to be regretted that so little notice has been taken of these events in standard works; even the few data which we obtain from such sources are so vague, that it is frequently impossible to identify the insects alluded to; † and yet such data are probably as essential to the understanding of the eccentric succession of these phenomena, as astronomical observations are to explain the beautiful revolutions of the planetary system.

The unaccountable presence of the turnip saw-fly, and especially of its black caterpillar, producing marvellous conjectures in the country, first led me to entertain a hope that the knowledge and services of men of science might do much towards smoothing the way to a correct knowledge of the natural history of insects injurious to the farmer. It is to be hoped that the veil of superstition has long since departed with our ancestors; but it is still necessary to dissipate the clouds of error which obscure the beauty of truth: this is the pleasing province of the naturalist, especially of the entomologist; and the natural history of the black caterpillar being perfectly understood,

* Innumerable instances might be adduced, but one will be sufficient:—*Allantus flavipes*, an insect of the same natural family as the subject of this memoir, which did not exist, I believe, in a single English cabinet previous to 1838, all at once became abundant in Battersea Fields, and the following year at Hampstead, feeding upon the common and white mustards, and it is now quite lost sight of again.—Curtis's *British Entomology*, Plate and fol. 764.

† In various accounts of the wireworm, totally different animals have been confounded under that appellation.

its progress can be traced from the egg to the fly so circumstantially, that the most sceptical need no longer remain in doubt respecting its economy. It may be admitted that the sudden and unexpected appearance of such multitudes of *caterpillars* might lead to the idea that they had fallen from the clouds; but when it is well ascertained that every caterpillar must have been produced from a minute egg, which egg must have been laid by a parent fly, it is not possible to reconcile such an idea with their habits and economy;* especially when we recollect that in most instances the caterpillars were at least half grown when discovered, which proved they had been living on something more substantial than air. When we take, however, a philosophic and more rational view of the subject, we shall see that it is quite possible that the parent *flies* may have been transported to our shores by winds setting in from Norway, Holland, or France, and, after attacking the turnip-crops on our coast, spread themselves over the country, if not in the same year, in the following season; and as *one* female would lay several hundreds of eggs, the rapid increase from myriads would be incalculable.

Fortunately for the farmer the visits of this angel of darkness "are few and far between," otherwise, the cultivation of this invaluable crop would become so uncertain as almost to compel him to abandon its culture. We have seen by a former paper† that the attacks of the turnip-fly are sufficiently vexatious; but the effects of the black caterpillar are infinitely worse, because the crop is destroyed after all the labour and expense attending its cultivation have been bestowed upon it, and generally at a period so advanced that it is in vain to attempt to repair the loss by diligence or industry. The only remedy is importation; and it is stated that, when the black caterpillars last appeared, many ship-loads of turnips were transmitted from the Continent to supply the deficiency along our coasts.

As it will be curious and interesting to take a retrospective view of the records of various writers regarding this insect, and useful in future investigations to watch the periods of its appearance, I shall now proceed chronologically with its history. In 1782, Mr. Marshall, whose observations are recorded with great accuracy, and with a truly philosophic spirit, stated that in July of that year the turnips at Southrepps, in Norfolk, situated about

* It seems to be well attested that *aquatic* animals, as fish and frogs, have fallen from the clouds with rain; but such occurrences are very rare and extremely *partial*. It is stated that fishes fell at Moradabad (see *Transactions of Linnean Society*, vol. xvi. p. 764), and frogs fell at Walham-Green (Fulham), on 1st August, 1846, during a tempest, in such a shower that they were taken up in shovelfuls (see *The Times*, August 3, 1846); but that the negro caterpillar should *always* fall in turnip fields would be very extraordinary.

† See chap. i. p. 15.

three miles from the sea, which looked remarkably well after a moist spring and fine weather, were observed to be covered with the saw-flies in such numbers that they were like flights of bees; and it was found that they had already traversed the coast, as the under sides of the leaves swarmed with young caterpillars, so that in ten days or a fortnight the turnip plants along the shore were entirely stripped of their leaves. Several days previously the flies had been noticed at Cromer, and Mr. Howse of Overstrand (who lived near the beach, and who was a man of good credit) declared, as well as the fishermen at Beckhithe, that they saw them arrive "in clouds so as to darken the air;" that, fatigued with their flight, they lay upon the cliffs 2 inches deep, and might have been "taken up by shovelfuls." * From these circumstances Mr. Marshall considers the flies had come over from the Continent; and fairly calculates that they might be transported from the southern cape of Norway to the coast of Norfolk in ten hours; and as they can live five or six days without food, they could cross from the most eastern confines of Russia, probably, before they were exhausted. Mr. Marshall subsequently remarked that the flies were very wild the third week in August, which he attributed to their being bred in the field; for those which he had captured three weeks before were not so alert; and this tends to prove, if it were necessary, that they had visited our shores from foreign countries.

If the insects take advantage of a gentle breeze lying off the shore in fine warm weather, they would have everything in their favour to depart; but as it often happens that a certain condition of atmosphere produces the same effects on the opposite coast, the flies would have the wind opposed to them on their arrival, which would account for their falling into the sea, and alighting in such multitudes on the cliffs; but this I am induced to believe is agreeable to their instinct, as flying against the wind when on land leads them to the plants they are in search of.† Mr. Milburn, however, viewing its flights in the turnip field, says,‡ "it never flies far; and thus the theory which would have them come from Norway is exploded, especially in the absence of all evidence of their existence there."§ Now, we know that the flight of locusts is generally very limited, and rather by leaping, at the same time expanding their wings to support them; but when

* See Mr. Marshall's paper in the *Philosophical Transactions for* 1783, vol. lxxiii., and an abstract from his *Rural Economy of Norfolk*, with a very excellent preface by T. S. N. Published by J. Fletcher, Norwich, 1836.

† See chap. i. p. 23.

‡ *Journal of the Yorkshire Agricultural Society*, p. 50.

§ *Athalia spinarum* is found abundantly in France and Germany. It is common in the southern portions of Sweden, is an inhabitant of Holstein, and is met with everywhere in Lapland.

impelled by instinct, they can fly to a very great distance; and who would think that the little quail, avoiding to rise on the wing by every art, had crossed the Channel before it could arrive at our shores? It has long been my opinion that the appearance of rare insects in this country is owing to their being brought over, guided by instinct and favourable circumstances. Indeed, in some instances, there cannot be a doubt of it;* and probably the stocks of our innumerable common species are occasionally augmented by the arrival of their cousins-german. The sudden disappearance of certain insects is only a proof that our climate is not suited to their habits and constitution for any long period. But to return.

Like the *Cicada septendecim* of America, the appearance of the turnip saw-fly has been supposed to occur about every seventeenth year; but this is not correct, for their visits have been so irregular that nothing can be determined from the data before us. The earliest record of their appearance was in 1756. Then we have notices of their being observed in 1760, and perhaps two years after, and again in 1782, 1806, 1818, 1833, 1835, 1836, 1837, and 1838, leaving intervals of three, twenty-one, twenty-three, eleven, fourteen, and one year. Probably they escaped notice in 1834; and if such were the case, they were ravaging our turnip crops for five or six successive years; and it is far from improbable that the fly may be found every year in small quantities, and that the recorded dates are merely the periods when their ravages called the attention of the country to the subject.

I believe its effects were severely felt in 1760; in 1782 many thousands of acres of turnips were entirely destroyed in Norfolk, and Mr. Marshall thought it probable that two-thirds of the turnip grounds had to be ploughed up and re-sown; and, from the farmers not being thoroughly acquainted with the economy of the insects, they allowed those plants to remain in the fields which had escaped by being under the hedges and trees, by which means the second crop was not unfrequently lost, as the turnips left supported the caterpillars until the fresh crop came up.

I do not find any account of the extent of the mischief in 1806, but in 1818, which was a very dry summer, they were in great numbers.

In 1833, Mr. Newport says, "The fly appeared in very large flights on the turnips at Meon Stoke, Hants, and nearly throughout that part of the

* Numbers of a large and beautiful moth, called *Daphnis Nerii*, figured in Curtis's *British Entomology*, Plate 626, were several years migrating from Africa to the north of France, and at last reached England, where that insect had probably never been seen alive before. Moths unknown as inhabitants of these islands have been caught at night at the North Lowestoft lighthouse, to which common species are attracted in such multitudes that the attendant, I have been informed by Captain Chawner and Mr. C. J. Paget, is obliged to take a broom in humid summer nights and brush them off, on account of their obscuring the revolving light.

country;"* possibly they received some check at this time, as no notice seems to have been taken of them in 1834.

But 1835, which was an unusually dry summer, might correctly be designated the "Canker-year," for they then seemed to have reached their maximum. Our journals and periodicals teemed with the ravages of the black caterpillar; and in walking through the turnip-fields the most casual observer must have been struck by the mere skeletons which the leaves often exhibited, the fibres only remaining, the membrane being entirely consumed. From the middle of August to the 20th of October, at which time they were full grown, I observed them feeding on the leaves of the turnips.† In September, in many districts, the mischief ceased; and some farmers, who sowed for turnips again, immediately after the first rains, were as successful as the lateness of the period would admit.‡ In the south of England, the second brood hatched, but in the north the weather set in cold, and no second brood came to maturity; seven-tenths, therefore, probably perished.§ On a farm at Coomb-bottom, near Kingston, in Surrey, the turnip fields suffered considerably; and in July, Mr. Manning ‖ had 24 acres of English turnips quite destroyed at Elton in Bedfordshire, except about 2 acres, which were not hoed out. "On Saturday morning," he says, "I first noticed the caterpillar very numerous, about three weeks after the turnips were up, growing luxuriantly and looking well; on Monday that part of the field which had been hoed about four days was entirely destroyed, and so they went on with this work of destruction, which was the most complete I ever saw . . . I then stopped the man hoeing the two acres that were left, and which came to a good crop." ¶ The Swedes close by the side of the white turnips were not touched. Early in July the fly was universally abundant, and about the middle of that month they were showered down in clouds at Godalming. ** I did not notice the fly in any great numbers until August and September, but I have found them as early as the 29th of March, and as late as the middle of October; I first observed them in abundance in a potato-field at Battersea, and afterwards in a field near Heron Court,

* *Observations, &c., on the Saw-Fly of the Turnip*, by George Newport, Esq.

† Curtis's *British Entomology*, vol. xiii. fol. 617.

‡ "Observations on the Economy of an Insect destructive to Turnips," by W. Yarrell, Esq., in the *Transactions of the Zoological Society*, vol. ii. p. 50.

§ "Report on the Natural History of the Black Caterpillar," by M. M. Milburn, Esq., in the *Journal of the Yorkshire Agricultural Society*, p. 49.

‖ *Transactions of the Entomological Society of London*, vol. ii. p. lxiv.

¶ It is remarkable that in a field of Mr. Goodlake's, at Wadley, near Faringdon, the unhoed part of a crop of Swedes escaped exactly in the same manner.—*Ph. Pusey.*

** *Entomological Magazine.*

Hants.* Mr. Saunders states that he never witnessed so great a destruction in turnip fields by the black caterpillar, as he did in August, near Dover. Very few fields had escaped, although some were less damaged than others, and the ravages were not confined to particular spots, but were evident in places far apart; that in many instances scarcely a vestige of green remained, and the tendrils and nerves which they at first refused became in the end necessary for their subsistence. He adds, "In a field at the back of the castle, which was half planted with Swedish turnips and the other half with the common kind, the former were untouched, but the latter greatly injured, although separated only by a furrow, the plants touching each other."† In Buckinghamshire, the blacks were so abundant and destructive, that a meeting of the farmers was convened to consider the best mode of cure; and it was stated that the Swedes had suffered equally with the others. At Compton, in Surrey, a turnip field of 8½ acres was completely demolished; and a thunder-storm, accompanied by heavy rain, destroyed myriads of the larvæ, so that basketfuls of the blacks might have been swept up the following morning.

At Long-Ditton, Ham, and Guildford, their ravages had been equally severe;‡ indeed it was difficult, perhaps, to find a turnip country that had not been visited by these black armies; even as far north as the county of Durham they had proved very injurious to this crop; and in Essex, Bucks, Kent, Sussex, Hants, Wilts, Dorset, and Somerset, the turnip crop was altogether a failure, for the produce of a second and even a third sowing was consumed by them.

In 1836 less was heard of them, yet in August I saw the flies coming out of the ground in myriads in a ploughed field in the neighbourhood of Bristol, where potatoes had apparently been grown; and a great many hundreds of acres were destroyed in Norfolk. Mr. Manning, also, of Elston, had about 70 acres of Swedes more or less infested, but not one was to be seen on the English turnips; and he says hoeing increased them a thousand-fold.

In 1837, the only notice seems to be from Mr. Sells, who says that near Arundel, in Sussex, the turnip fields in July were in some places completely laid waste.

Thus their attacks became gradually enfeebled, when the intense cold of January, 1838, arrested their increase; the severe frost, unaccompanied by

* Curtis's *British Entomology*, vol. xiii. fol. 617.

† "Notice of the Ravages of a Black Caterpillar, &c.," by W. W. Saunders, Esq., in the *Transactions of the Entomological Society*, vol. i. p. lxxvi.

‡ See a communication by W. Sells, Esq., in *Trans. Ent. Soc.*, vol. ii. p. lxxviii.

snow, left the ground exposed, so that the inmates of all those cocoons that were not deeply buried were frozen; and it is probable that the thaw acted as beneficially, by subsequently destroying the remainder, either by decomposition, or rendering the earth too wet and cold to bring them to maturity. They did not, however, finally take their departure, for, if I be not in error with regard to the date, I find one instance recorded of a brood making its appearance the year following at King's-Weston, near Bristol. But I will transcribe Mr. Miles's own account, as it is interesting for several reasons:—"The turnip crops went on together very well until the 8th of July, when I perceive by my farming-book that the black caterpillar first appeared. Its ravages were extended to both crops indiscriminately; as usual, however, with me, it attacked the field in patches, making sad havoc with the Swedes, and entirely skipping over four rows of mangel-wurzel, which had been placed between the Swedes and red-rings by way of experiment—to ascertain whether that plant could escape when surrounded by a crop infected by the caterpillar." *

Before entering upon the history and economy of the turnip saw-fly, a few remarks upon the tribe to which it belongs will not be uninteresting, for amongst the hymenoptera, the order in which it is included, there is no family which does so much mischief to plants as the tenthredinidæ; indeed, a very large portion of the innumerable ichneumons and sand-wasps are of essential service, being the parasites which infest and devour noxious insects. Neither trees, bushes, gardens, nor fields are, however, exempted from the attacks of the caterpillars of the saw-flies. The largest species feed upon the birch, willows, and white-thorn.† The coniferæ, or fir-trees, are stripped of their leaves by *Lophyrus rufus*, *pallidus*, and *pini.*‡ Fruit-trees, as the peach, plum, cherry, and the pear especially, suffer from a bottle-green shining slug-like larva, with several other species, and amongst them a *Lyda.*§ Gooseberry and currant bushes are often entirely stripped of their leaves, and the fruit rendered small and unsaleable, by the depredations of *Nematus trimaculatus;* ‖ and our beautiful roses do not escape the ravages of several species, amongst them *Hylotoma Rosæ*¶ and *Athalia Rosæ*, which are so nearly allied to the turnip saw-fly that a casual observer

* *Royal Agricultural Journal*, vol. i. p. 417. "Experiment with Poittevin's Manure," by Wm. Miles, Esq., M.P. I have since learned that a crop of turnips belonging to the Rev. C. Clarke, of Hulver, in Suffolk, was seriously injured in 1838.

† See Curtis's *British Entomology*, Plates 41, 49, 89, 93, and 97, where dissections and descriptions of five genera will be found.

‡ Ibid. Plate 54.

§ Ibid. Plate 381.

‖ "Ruricola," in the *Gardener's Chronicle*, No. xxxiv. p. 548.

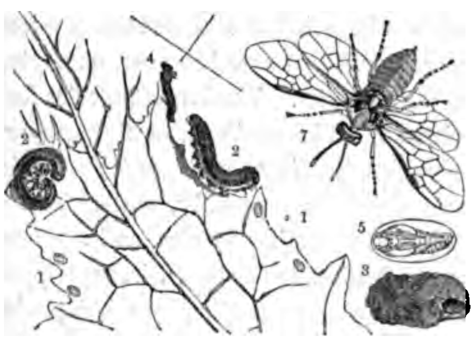
¶ Curtis's *British Entomology*, fols. 65, 436, and 457.

would consider them to be the same species: they are, however, confined to rose-trees, and the first is distinguished by the shape of the horns and the nervures of the wings. If it were immediately applicable to the subject, many more species could be added to the above; but enough has been stated to show how necessary it is to be acquainted with this branch of natural history, if we desire to comprehend the causes that are hourly operating to thwart our labours.

It will be remembered that the turnip-beetle, commonly spoken of as the turnip-fly, belongs to an order called Coleoptera, but the turnip saw-fly is included in one called HYMENOPTERA, from the four wings being membranous and generally transparent; and this order embraces an extensive family called Tenthredinidæ, which is composed of many genera, one of which is termed ATHALIA, comprising six or seven species, natives of Great Britain; to this genus our turnip saw-fly belongs, and is called SPINARUM by Fabricius; it was subsequently named *centifoliæ* by Panzer, which is to be regretted; but it was done unwittingly by that author, he not knowing that it had been previously described.

Athalia spinarum may be thus characterized:—Both sexes are of a bright orange colour, and shining; the male, however (Plate B, fig. 6), is considerably smaller than the female (fig. 7; and No. 3, fig. 7), and more slender in shape. The horns are inserted near the middle of the face — short, black, and club-shaped; they are of a dull yellow colour beneath, excepting the base and apex, but in the male the two basal joints are also yellow beneath, and more or less so above; they are composed of nine joints, the two first are nearly oval, the third is long, the fourth not longer than the first, the following joints decrease in length, but increase in diameter, the terminal one being the stoutest, oval, and nearly as long as the third, with a suture across the middle (fig. 11). The head is black, short, and broad; the mouth yellow; the *labrum*, or upper lip, is somewhat quadrate, bowed before (fig. 10, *m*). The teeth, or *mandibles*, meet in front, their apex being curved and forming a claw, of a chestnut colour, with a small tooth on the inside (*n*). The jaws, or *maxillæ*, are drawn out and terminated by a leathery lobe, with a long lance-shaped one on the inside, which is very downy (*o*).

No. 3.



The two feelers, or *palpi*, are long, angulated, downy, and six-jointed; the basal joint is short, and the remainder nearly of equal length, the sixth being the slenderest, and slightly spindle-shaped (*p*). The chin, or *mentum*, is long, horny, and obovate (*q*); the two feelers, or *palpi*, are much shorter than the others, and attached to the anterior angles of the chin; they are four-jointed, and bristly towards the apex, the joints being nearly equal, the terminal one having the apex excavated on the inside (*s*). The under-lip, or *labium*, is large, leathery, nearly orbicular, formed of three lobes, the centre one being narrow (*r*). Eyes lateral, oval, and black, with three minute eyes, called *ocelli*, on the crown of the head, forming a triangle. Thorax globose, broader than the head, especially in the female, the anterior portion forming three reddish-orange lobes; a spot on each side, the scutel and the tip of the hinder scutel of the same colour. Abdomen or body short, somewhat cylindrical in the male; the apex rounded (12); much broader and more depressed in the female (13), the apex pointed, with an ovipositor partly concealed in a slit beneath (*t*), and porrected between two rigid spoon-shaped lobes or valves (16), hollow inside, but convex and very hairy outside; they are ochreous, with a black patch at their apex (*u*), and inclose four fine lancets, the lower or outside ones (17) being the longest, and the upper and more inner ones being a little shorter (18); they are all thickened at the back, the sides have twelve or fourteen ridges, and the thinner margins are slightly serrated at the points, which seem to be most acute in the inner pair: there are also two united blackish spots at the base of the body, and a black dot on each side. Wings four, ample, all reticulated, iridescent, yellowish at the base, the thickened costal margin and the callous stigma pitchy; the superior wings are the longest, with two marginal, four submarginal, and various other cells, formed by reticulated nervures. Legs six, rather short (19); thighs stoutish (*v*); shanks or *tibiæ* clavate, all hairy, with a pair of acute unequal spurs at the apex, and tipped with black (*w*); *tarsi* or feet rather long, whitish, and five-jointed (*x*), the four first joints having little appendages or suckers beneath (*y*); tips of all the joints black, the apical one entirely black, as well as the two acute claws with which this joint is furnished; there are also attached to them two little suckers, called *pulvilli* (*z*).

The males are hatched first, and appear a few days previously to the females, which sex is not only larger, but, the size of her body being greater, she looks of a brighter orange colour, and may be thus detected even when upon the wing. It generally happens that the female saw-flies are much less abundant than the other sex, and this is believed to be the case with the kind of saw-fly we are now describing, the males being as six to one when they have been bred; but it has been exactly the reverse in those I have caught in the fields, for out of fifteen specimens there were only three males. Both sexes can be equally active, but on being touched they feign death; closing their wings and contracting their legs and horns, they look like shrouded bodies; they are also torpid in moist and cloudy weather, but very alert when the sun shines, the males playing with each other or sporting with their mates. They use their wings much more than their legs; and when a female is observed walking about a leaf, it is for the purpose of depositing her eggs. They are frequently found on cruciferous and umbelliferous flowers, upon the pollen of which the flies subsist; and Mr. Marshall says they are partial to honey, and will sip the sap which oozes from the broken end of a turnip-leaf.* The fœces are cream-coloured, and of a similar consistence, but become a white powder when dry. Like many other animals, they repose after the heat and fatigues of the day, and generally rest beneath the leaves or in the flowers, with their heads and bodies bent down, and their antennæ lying close, until the rays of the morning sun awaken them to their toils.

The saw-flies generally appear in May, sometimes earlier, when the males fecundate the eggs in a few seconds, but this only takes place in the hottest sunshine, whilst the female rests upon a leaf, as is the case with the white cabbage-butterfly; after which she immediately begins to deposit her eggs: she first examines a leaf with the point of her ovipositor, and then, fixing herself upon the edge, with her legs equally placed on both sides, holding particularly fast with the hinder, for which purpose the suckers are admirably adapted, she thrusts her saws into the margin, makes a shallow slit, and insinuates the instruments (figs. 17 and 18) obliquely, sometimes nearly parallel, into the edge of the leaf backward: having forced them in nearly to the base, she brings them round, forming the segment of a circle, and thus separating the cuticles she forms a cavity with her saws or lancets, which may be readily seen with the aid of a lens, by holding the leaf up to the light. The cutting this cavity often occupies half a minute, when the oval, whitish, and semi-transparent egg passes through the united lancets, which form a tube to conduct it to its nidus; the fly, at the same time, injecting a small portion of fluid,† which keeps the eggs moist, and prevents the cuticles from withering and collapsing upon, or exposing it to sudden changes of temperature and other casualties. The four lancets are then leisurely with-

* Other species, as *Tenthredo scrophulariæ*, *T. viridis*, &c., are not satisfied with this light food, but live upon soft-bodied insects, and will even attack the *Telephori* (Curtis's *Guide Gen.* 317, and *Brit. Ent.*, Plate 215), so that the *larvæ* are phytivorous, whilst the *imagos* are insectivorous.

† See Mr. Newport's valuable Essay.

drawn and returned to the abdomen until the operation is repeated, and five or six eggs (figs. 1, 1; and No. 3, figs. 1, 1) are thus laid in distinct cells, in about twenty minutes.* Such are the care and instinct manifested by the female, that, if she commence to penetrate a leaf where there is not room, or if there be any danger from the leaf being curled, or too near an egg already deposited, she relinquishes her object until she finds a more suitable spot; and she has never but once been detected laying her eggs in the seed-leaves, so provident is she of the future wants of her progeny, well knowing such leaves would possibly be withered before the eggs hatched. Mr. Marshall placed a female upon a succulent leaf of the rape (*Brassica Napus*), but she refused to deposit any eggs, although she did so immediately on being put upon a young turnip leaf; this she effected twice, and afterwards laid an egg on the margin of a large hole eaten in the leaf, which is attended with greater difficulty than in her more usual way on the outside edge: the outer rough leaves are undoubtedly those which best suit her purpose, but she often selects the leaflets near the base, where the eggs rest more secure, and scarcely ever places them near the upper end.

It is supposed that the flies live twelve or fourteen days from their birth, but the females die as soon as they have finished laying their eggs; yet such is the vitality of that sex, that she will not only survive the separation of the head from the trunk, but has been able to walk, run, and attempt to fly, three hours after decapitation. Mr. Marshall had one, standing and dressing its wings for many hours after losing its head, and it actually lived in this state upwards of three days.

A single female is capable of laying from 250 to 300 eggs, and sometimes she deposits 20 in a single leaf; in five days, or perhaps less, in fine warm weather, the eggs are hatched; but if the atmosphere be chilly or wet, it is six, seven, and even ten or eleven days before the young caterpillars eat their way through the shell with their little jaws (fig. *f*), and crawl through the shining and dilated cuticle; and their heads at that period being larger in diameter than their bodies, they soon extricate themselves with their fore-feet; this takes them, with intervals of rest, from fifteen to twenty minutes. When they first emerge from the shell they are scarcely visible, being only about the tenth part of an inch long; at that time they are nearly white, excepting two dots on the head, but soon become of a dull semi-transparent greenish-white colour, the head jet black and shining. In less than two minutes they begin to feed upon the tender under side of the leaves so voraciously, that in a few hours these are often drilled through. At this

* We were first indebted to Mr. Marshall for these careful details, which have been verified by Mr. Milburn and Mr. Newport.

period it is difficult to shake them off, so closely do they cling to a leaf; but when they are about six or seven days old they cast their first skin, and then they are easily dislodged: they have now doubled their length, being one-fifth of an inch long; some of them, probably the female caterpillars, are much longer, and almost jet black, a stripe on the side of the belly being considerably paler; and at first the head is whitish, with two black dots. They are at this time very voracious, and may be traced by their large green pellets of dung; having fed for some time, their skins will no longer expand to the extent required, when each caterpillar again fixes its membranous legs, especially the hinder pair, to a leaf or the denuded fibre, and, bursting the seam behind the head, the caterpillar crawls out, leaving its skin attached to the object it stood upon (No. 3, fig. 4): it has now greatly increased in size, and, consequently, its ravages are much more evident, and it soon has to cast its skin again; the larvæ now have a more transparent but wrinkled skin, and are of a slate or gray colour, with a pale line along the sides, the under side being pale also; but the head is black, as well as a varying line along the back, being the alimentary canal: thus they change their skins three times, at intervals of from six to seven days. When full grown they are often three-quarters of an inch, rarely an inch long, and about as thick as a crow-quill, but frequently do not attain to more than half an inch in length; and after changing their last skin they decrease in size: this takes place in about three weeks from their birth, but when well fed in confinement, they have arrived at maturity in nineteen days.

The full-grown caterpillars are nearly cylindrical, not in the least hairy, and composed of twelve segments besides the head; each segment is covered with minute warts, and formed of six or seven rings of muscles, which give them a wrinkled appearance, and there are plaits of muscles on the sides (figs. 2; and No. 3, figs. 2); the head is much smaller than the body, especially the thoracic segments, which are a little inflated, the remainder taper slightly to the apex; the face is orbicular and pubescent (fig. 8), with a short conical six-jointed antenna seated on each side near to the base of the lip (*c*), and above each is a minute black hemispherical eye (*b*); the upper lip is horny, semi-circular, and notched in front (fig. 9. *e*); the jaws are very strong, horny, and subtrigonate, one with two, the other with four unequal teeth at the apex (*f*); maxillæ (*g*) with a leathery lobe, and a smaller one on the inside, pectinated at the apex (*); the feelers are short, conical, and five-jointed (*h*); chin abbreviated (*i*), producing two very short conical feelers composed of three joints, the second notched, with a curved spine on the inside (*l*); the under lip is fleshy, rather large, notched in the centre, where there is a small lobe (*k*). The larva is furnished with twenty-two legs, the six pectoral are short and horny, formed of five joints, and terminated by a minute claw (2, *a*); the fourth segment has no legs, but the seven following are each provided with a pair of short cylindric ones, and the apical segment has a fleshy pair at the extremity, with which the animal can hold very fast.

The larvæ delight in the sun, and lie curled up upon the leaf (2*) enjoying its piercing rays, and from this capability of enduring heat, as well as from their colour, they may well be designated "the negro caterpillar." When they feed they either fix themselves by their six pectoral feet to the edge of the leaf (2†), or begin to eat off the surface for a small space, when they perforate the other cuticle, making a hole, which they enlarge until it is one or two tenths of an inch in diameter, and as the leaf grows this increases, provided the whole leaf is not consumed, so that, when the succeeding brood is hatched, abundance of secure niduses are thus provided for their eggs. Mr. Newport discovered that whilst they were in their first skins they had the power of emitting a silken thread, to let themselves down when shaken from a leaf, like the caterpillars of the geometræ and smaller moths, which enables them to regain their position after the alarm is over; but when farther advanced in life they lose this power, and are consequently obliged to crawl up the stem until they reach a leaf; after this period they fall on the slightest touch, and lie curled up as if dead until their apprehensions of danger have subsided.

They are not long, after assuming the slate colour, before they descend from the leaves and enter the earth, and are sometimes two hours and a half engaged in burying themselves 1 or 2 inches below the surface, where they form an oval silvery cocoon of silken threads and gluten,* more or less brown outside (fig. 3; and No. 3, fig. 3), but of a beautiful smooth silvery texture within: it is impervious to wet, and its glutinous nature when first spun causes it to adhere to the particles of earth and sand in which it may be imbedded, so that it appears like a small lump of earth, and is not easily detected; but when formed in a box it partakes of its colour on the outside, and requires a knife to detach it, and then it cannot be well separated without making a hole in the case. Some of the early broods pass very rapidly into the perfect insects, three weeks being sufficient, and the females were found already to be full of eggs; but later in the season it is three months before they change to pupæ, and, in order to secure a succession the following season, probably one-third remain in the cocoons in the caterpillar state through the winter (fig. 4): eventually, however, the caterpillar casts its skin in the cocoon, and becomes a whitish-yellow nympha or pupa, the

* This substance is said by some to be an exudation from its body, but I believe it to be spun, like the cocoon of the silkworm, from its mouth.

limbs and figure of the adult fly being distinctly visible through the thin skin (fig. 5; and No. 3, fig. 5).

Having traced their progress and economy from their first appearance as flies to the pupa or chrysalis, the next object for consideration will be the remedies; but before we enter upon this subject, there are some facts that we have collected in our investigations which deserve especial notice: one of which is, that light soils seem to be most attractive; for instance, the coast of Norfolk, where the saw-flies were first observed in such multitudes, is exceedingly sandy; Mr. Yarrell says they affect light and chalky soils: in another district the sharpest gravel was infested the most; and where it was a sandy loam upon mountain limestone they proved very destructive, and attacked the crops in patches;* but the most inexplicable trait in their economy is, that, whilst in some places and in some seasons the caterpillars refused to eat the Swedish turnips,† in other instances they shared the same fate as the English varieties, or were even exclusively attacked. At first this led to a belief that the leaves of this variety of *Brassica campestris*, containing a greater portion of oily matter, and being more pungent to the taste, than *B. Rapa*, they were altogether secure from the black caterpillar; this, however, in the sequel, proved unfortunately a decided fallacy: yet how interesting, and perhaps beneficial, would it be to reconcile these anomalies, if we had sufficient recorded facts to assist in such an undertaking. There seem to be fair grounds for believing that the saw-fly does give a preference to the English turnip, but rather than be disappointed, she will deposit her eggs in the leaves of the Swedes, and it is possible that they afford the larvæ more wholesome food in wet weather: it would be easy to enlarge upon like inquiries, but, as we have no means of answering them, it seems idle to do so. The caterpillars appear to be naturally fastidious, for when feeding on an old leaf they do not relish a younger one, being clearly partial to that which gave them birth, the juices I conceive being more congenial to their constitutions, especially in their early stages, which may account for the silken thread with which they are then provided to guide them back to their native spot; when half grown they spare none of the older leaves of *full-grown turnips;* indeed, their instinct shows that the outer rough leaves are best suited to their wants, for the eggs being laid in them they first fall a sacrifice, whilst the central ones nourish the plant,

* *Royal Agricultural Journal*, vol. i. p. 417.

† I myself so invariably witnessed this preference, that I unhesitatingly stated, in 1836, "they would not touch the Swedes" (Curtis's *British Entomology*, vol. xiii. p. 617); and in the *Entomological Magazine*, vol. iii. p. 340, Mr. Newman says, "It was remarkable that at Godalming the Swedes were untouched."

daily becoming more developed, and, consequently, better adapted to their increasing and inordinate appetites. The charlock (*Sinapis arvensis*) is decidedly their favourite food, for they always attack that first, and will feed upon the flowers as well as the leaves. The period of the caterpillar and eating state is about three weeks, during which an individual will consume a very great quantity of food, but how many times its own weight, when fully grown, has not been calculated; at this time they are exceedingly voracious, and, of course, most to be dreaded. The caterpillars are generally discovered under the leaves when the plants are about three weeks old, and they daily increase in numbers from the successive hatching of the eggs, so that they vary greatly in size and colour in a short space of time, and, as the swarms of flies pass in a body from one spot to another, the larvæ do not appear simultaneously; indeed, they may be seen full grown in one field, whilst in a distant locality the saw-fly may be depositing its egg. But this arises from another cause—the numerous broods that hatch in one year; for the larvæ arrive so soon at maturity, that a second brood of flies is produced in July and August, whose eggs are deposited forthwith, and thus a third brood is feeding in congenial seasons until the middle or end of October, which is frequently a warm and dry month; but, should hoar-frosts set in at this declining period, multitudes will be seen perishing on the leaves and ground. A low temperature generally arrests their progress, but as soon as it becomes again mild, all flattering hopes vanish with the suspended growth of the bulb; it pines away from the loss of the leaves, which are the lungs of the plant, and, even should it survive their attacks, it never can arrive at its full size.

Mr. Marshall states that in about ten days after the arrival of the saw-flies the young caterpillars were visible beneath the leaves, and in about ten days more the plants were entirely eaten up, excepting a small patch or two towards the centre of the field, and a space round it by the side of the hedge, proportioned to its height, and varying in this respect where trees occurred: this was accurately ascertained, and is a very curious fact, for in small pieces called pightles, set round with high trees, the plants had almost entirely escaped; and, as might be expected from this evidence, large open fields and smaller inclosures lying exposed to the sea suffered most, and lands dipping from the sea were less affected. It seems probable that the shade produced by the trees and hedges, or the moisture under them, would not prove favourable to the hatching of the eggs, for, as soon as the other parts of the field were consumed by the caterpillars, they proceeded to devour the space on one side, and then "travelled with wonderful instinct in bodies towards the other." The whole field being finished, the gateway and the adjoining roads had, it was said with great confidence, been seen black with them.

In Mr. Newport's *Prize Essay* we find that, when he inspected a field in Hants, of healthy white turnips, of 15 or 20 acres, which had been sown about a month, the saw-flies swarmed over about an acre at one end. They seemed to have arrived very recently in a swarm or cloud, for they had not been observed there before, and were hourly increasing. But the remarkable fact was, that the great mass of the flies was confined almost entirely to the eastern end of the field at first, while there was scarcely a fly to be met with in the middle or at the western end; now it appears there was a light westerly wind at the time, and the saw-flies had come in an opposite direction, confirming the opinion, given in the *Report of the Turnip-fly*, that insects, being directed by scent, frequently fly against the wind. In four days they had passed over in a body to the western end, depositing eggs in their progress, from whence they would proceed to other fields hitherto free, if the ovaries of the females were not exhausted: Mr. Newport had observed in another instance that they came from the east.

It is well known to all practical entomologists that caterpillars are attacked with purging when fed upon wet leaves, and this disease makes sad ravages amongst the "silkworms," if proper precautions be not taken in rearing them. Rains are consequently singularly destructive to the black caterpillars, by rendering the turnip-leaves very watery, which speedily kills them: the caterpillars can undoubtedly resist a shower, yet, if they be brushed off in wet, cold weather, after casting their first skins, I doubt if they would recover; and on the contrary, if the earth be very dry, I expect they would not regain their position without difficulty, especially on sandy soils, over which they travel very indifferently, and for this reason probably, they migrate in troops at night when the earth is moistened with dew; but these are merely hints thrown out for the more mature consideration of those most interested in the subject. There are, however, many other causes in operation to decrease this formidable enemy, which probably might be taken advantage of; for instance, if a caterpillar be removed after it has fixed its fleshy feet to any substance in order to cast its skin, it has not the power to attach itself a second time, consequently it cannot disengage itself from the old skin, and it dies: this operation takes place every six or seven days, as already shown, and such would be the best periods for disturbing them: when the caterpillars are preparing for this moult they become unsettled and will not eat, but as soon as they have cast off their skins all their vigour returns with redoubled force, and they are more ravenous than before. When they have overcome the exertions of their final moult, if the earth be very dry it is greatly against them, for the larvæ do not like to enter it, I have repeatedly observed, as they do when it is moist. Probably they are obliged to bury themselves deeper under such a condition of the soil, until they arrive at damp earth, which will allow them to form their cells; they are also longer burying themselves when the earth is dry, and I believe descend close to the bulb of the turnip, as the most protected from drought; and this operation requires several hours when they are in any way enfeebled, but is otherwise speedily accomplished.

Rooks, as usual, are eminently serviceable in diminishing the caterpillars; and Mr. Marshall observed that "a large piece of turnips lying in an open field had escaped in a remarkable manner; it lay near a rookery, which was a general rendezvous for these birds; and I recollect," he adds, "to have seen this piece more than once covered with them." The swallows also soon become attracted by the flies, and are constantly skimming over the fields in pursuit of them; and, when it is remembered that the capture of one female may prove the destruction of a very extensive brood of the caterpillars, the benefit conferred by a single bird, from the prodigious number it would destroy in a few days, is scarcely to be calculated.

It is remarkable that so few parasitic insects seem to be attached to the turnip saw-fly, which may be one cause of its rapid increase; but I believe that the currant saw-fly is equally free from such enemies.* I have bred a considerable number of both species, yet I never detected a caterpillar that had been stung, or in any way inoculated by parasites; I am therefore led to conclude that it is of rare occurrence. A friend, however, sent me an ichneumon which appeared to be bred from a cocoon the beginning of May; it is, I believe, a *Bassus* of Gravenhorst,† and is black, minutely punctured and finely pubescent; the horns are as long as the body; the mouth and lower part of the face are white, with a black stripe down the middle, and two points on each side of the clypeus of the same colour; the labrum and tips of the mandibles are ferruginous brown; the wings are iridescent, the costa and stigma fulvous, the nervures brown, and there is no areolet; the legs are rather stout and rufous, the coxæ ochreous, the tarsi and hinder tibiæ are tawny, the latter with the terminal half and the tarsi black. It is 2¾ lines long, and the wings expand nearly 5½ lines—not quite half an inch. As it does not appear to be described by any author, I propose calling it *Bassus athaliœperda*, the "Athalia-destroyer." Mr. Yarrell has also figured "a dipterous parasite (one of the muscidæ), which, having completely devoured the interior of the larva, has undergone its

* *Gardener's Chronicle*, vol. i. p. 548.

† Curtis's *Guide to an Arrangement of British Insects*, Genus 520.

change to a coarctate pupa within the skin of the larva of the Athalia, portions of which (greatly stretched) are seen remaining on the outside of the dipterous pupa, as well as the head of the larva, which remains entire."* From our present knowledge, therefore, we have no just grounds to expect assistance from insectivorous parasites, which are often so admirably employed to keep in check the insects that are injurious to man; it is, consequently, to his own resources that the agriculturist must look for either a preventive or cure; and, with this view, we will now proceed to the remedies proposed: many of them, however, are mere palliatives, being limited, imperfect, and uncertain in their operations, whilst others have been attended with universal and complete success.

Mr. Saunders says, that "lime-dust, or powdered chalk, had been spread over the attacked half of a field, and apparently with beneficial results, but few caterpillars remaining;" in another instance, strewing quicklime, and renewing it as often as the wet or wind rendered it necessary, was most beneficial; but other parties found sowing with lime in the middle of the night, when the plants were moist with dew, had no effect; quicklime and soot were tried with no better success, and scattering slaked lime or coal-ashes over the plants is said to be useless; as it is admitted that in consequence of this application the larvæ rolled off the leaves, I do not concur in its inutility, and I think that it might be attended even with good success, if it were done after rain or in damp weather, for, on being touched, the larvæ curl themselves up and fall to the ground; if, therefore, they were brushed off in the evening, and the dusting of lime with wood or other ashes were immediately to follow that operation, I doubt not but myriads would perish, especially if the succeeding night proved cold and frosty, as is not unfrequently the case in September, and I believe even in August; indeed, such is reported to have been the result. As, however, it is stated that when shaken off, the active caterpillars will regain the leaves by day in five minutes, except under circumstances already alluded to, it is evident that such applications must not be delayed, if any advantage is expected to be derived from dusting or watering them upon the ground.

A heavy roller passed over the field in the evening and at night, is said to have destroyed the caterpillars whilst feeding, and to have checked them, especially when repeated two or three times, but it did not save the crop. It is only at an early stage of the turnip's growth that rolling can be of service, for when the plants have arrived at any size, as they generally have

* *Transactions of the Zoological Society*, vol. ii. Plate 14, fig. 12.

when I have seen them thus attacked, they must be injured by such a process, and the roller itself cannot come in close contact with the soil.

Whilst any attempts are making to diminish or to extirpate the caterpillars, the turnips should not be touched with the hoe; few of the larvæ are killed by the operation, and, as their food is thereby reduced possibly one-half, the remainder more speedily, and with greater certainty, falls a sacrifice to their ravages; moreover, hoeing, by loosening and refreshing the earth, renders it more agreeable and better suited to receive the full-grown larvæ, when they are led by instinct to bury themselves. But as soon as the caterpillars have disappeared, the hoes may be set to work with great advantage where the crop is only partially injured, for then it will disturb and destroy multitudes of those that have entered the earth; and if this could be immediately followed by throwing salt and water from a water-cart over the crop, it would have a most beneficial influence, and this could be effected without much difficulty or detriment where the turnips are drilled in; and the same liquid, or even common water, if thus applied the instant the saw-flies make their appearance, would drive them away also, as such a state of the plants is not adapted to the deposition of the eggs; and the saw-flies themselves, although, from their polished surface, the pubescence which clothes some of their members, and probably from an oily exudation, can easily recover when they fall into pure water and escape from its surface; yet, when they are forcibly washed off the plants, and get entangled with the soil, as lime, clay, or any other earthy matter, especially in cold weather, the greater portion of them would be rendered incapable of doing further mischief. On the sea-coast, where they have generally first appeared, salt water from the sea might often be advantageously employed; and the dusting of finely-pounded salt over the field would do great service, if it were scattered whilst the turnips were wet from rain or heavy dews. Mr. Newport justly observes, that sea-water, or salt and water, is likely to prove useful, for two reasons—"First, from the known pernicious effect of saline matters *in solution* upon most young insects; and next, the circumstance of a greater amount of cold being produced during its evaporation, whilst the means applied as a remedy for the insect, would, on most lands, prove beneficial to the soil, and hasten the growth of the crops."

Drawing a cart-rope over the turnips, to shake off the caterpillars, is sometimes very effective, but not always to be depended upon. Mr. Sells says, that two men were employed in the middle of September to sweep 6 acres of turnips at Kingston, with an inch-rope about 30 feet long; it took them one hour each time, and was daily repeated for four days with great success, vast numbers of the larvæ being found dead under the turnips.

This operation ought to be performed in the evening, taking advantage, it possible, of a wet day; and should the larvæ not have arrived at maturity, so much the better, as all those that are moulting must perish. A better plan, perhaps, is to take an axle-tree connecting two wheels, and lash some branches of the green furze* to it at such a height, that they would brush the turnips without pulling them up by the roots; this not only has the same advantages as the rope, but great numbers of the caterpillars are wounded and destroyed by the thorns; if furze cannot be readily procured, branches of the fir tree or hawthorn may be substituted. A hurdle bushed with smooth boughs, and drawn down the rows, has also had a good effect, but it must be repeated two or three times.

The elder has long been celebrated for its virtues in repelling the attacks of insects, and in the canker years it has been tried in various ways, sometimes with success; but possibly many other trees, employed in the same manner, would have proved just as serviceable: for Mr. Marshall's experiments clearly showed that the elder is neither noxious nor disagreeable to the black caterpillar; even a turnip leaf, which had been *whipped* with the elder, was eaten by them when they were confined with it in a box. The benefit alluded to was derived from the use of a brush made of the young straight luxuriant shoots of the elder, about 2 or 3 feet long, and as thick as one's finger; these were tied to a cart-rope 20 feet long, with rope-yarn 4 to 6 inches apart. Two men then took hold near the twigs, the loose ends of the rope being tied together, and dragged the elder at a distance behind; of course the rope may be prepared of any convenient length for the men to walk along the furrows, but 20 feet will take in a rod at once. Mr. Marshall also reports another successful case. In a field that was partly sown early, the saw-flies† appeared when they were in rough leaf; this portion was entirely cut off by the black caterpillars, so that it was necessary to plough and sow a second time; but the ploughing and harrowing did not kill all the larvæ, for thousands were seen on the surface travelling towards the portion of the field which had been late sown, the plants of which were of a considerable size; a trench was immediately cut to divide the two portions, and two men drew the elder bushes over the turnips thrice a-day, at morning, noon, and night, which employed them an hour and a half each time to go over about 3 acres. This was continued for ten days, and the elder was renewed three times. Whatever might be the cause, "after looking attentively

* The *Ulex Europæus*, called in some counties gorze, or gorse, and whin.

† It is most essential for agriculturists to call these flies saw-flies, and not merely "the flies," in consequence of the turnip-beetle being also called the "fly," otherwise great uncertainty and confusion may be the consequence in future investigations.

for some time among the plants, I saw only two caterpillars, and so healthy a piece of turnips I do not recollect to have seen; they have been sown only three weeks, yet they are now fit for the hoe."* Mr. Marshall attributes this success to the complete and continued vibration of the leaves given by the straight elder twigs lying flat and even upon them as they passed over.

When turnips are sown in ridges, a number of women have been advantageously employed with live twigs to brush the larvæ off, crushing them with their feet as they passed on, being "closely followed by a man with a scuffler, set so as to cover the whole space between the plants; and by once or twice going over the field was cleared."†

It was a universal practice in Norfolk, which had generally a good effect, when one portion of a field was swept off by the larvæ, and they were marching to a less infested portion, to draw a furrow between them, deepening it into a trench. The side next the part to be protected should be made, of course, perpendicular, or even overhanging at the top, if possible: thus a trap is laid, and the bottom of the trench will soon be entirely covered with them. It is likewise a very sensible precaution, when there are signs of the caterpillar in one field, to cut such a trench across a gateway connecting it with another inclosure where there are no symptoms of its presence. If water rise in the trench, so much the better; if not, the bottom may be filled with straw, and set on fire when the caterpillars have accumulated in sufficient numbers, which is a very speedy and excellent mode of destroying them.

Hand-picking and ducks are, however, most to be relied on; it is true that the former is tedious, if not expensive, where the caterpillars are so numerous that as many as sixteen score have been counted on one large plant; but in such cases they should be brushed or whipped off into fruit-baskets or sieves; otherwise pint or smaller pots are well adapted for collecting them, which can be emptied into large covered vessels at the head of the field, containing some salt and water, or lime-water, to prevent the caterpillars from crawling out. Mr. Sells states that a boy ten years old gathered the caterpillars in a field suffering in a slight degree, at the rate of 180 in an hour; eight hours per diem would give nearly 1500, or 9000 a-week; so that ten or twelve children, from six to ten years old, would collect 90,000 or 100,000 in a week, where they are *not* abundant; in such a case, 6*d.* a pint, and 2*s.* a-day to the superintendent, would probably answer the purpose.‡

* Abstract from Marshall's *Rural Economy*, p. 18.
† *Transactions of the Yorkshire Agricultural Society*, p. 54.
‡ *Transactions of the Entomological Society*, vol. ii. p. lxxviii.

Mr. Manning says, "Pigs will destroy the larvæ to a very great extent, and without injuring the crop in the *slightest* degree;" but that 160 young ducks soon put a stop to the black caterpillars. Ducks, having been tried with universal success, are decidedly the favourites: they are also useful to eat slugs and other small animals destructive to field-crops and vegetables. Poultry are said to be equally beneficial, with the exception of turkeys, which will not touch the negro caterpillars. Fowls are naturally fond of worms and caterpillars, so much so that hens' eggs, when they feed much on meadows and mountains, without corn-food, are not well flavoured. It is therefore not difficult to induce them to make the most of their time, when they are invited to such a luxurious banquet. Indeed it is supposed to be most judicious to turn in *poultry* where the caterpillars do not abound, as they will search them out, and leave the turnips uninjured; whereas the ducks, under such circumstances, would attack the turnip-tops, and thus the remedy might prove as bad as the malady.

Hundreds of ducks were turned into a field in Kent, which saved the crop; and by this method Mr. Osborne, of Birdham, in Sussex, preserved his turnips. Eighty ducks from Leadenhall market did not work well the first day, but on the following they quickly accomplished their allotted task, thriving upon their new food. At Long-Ditton the ducks and fowls proved equally useful. At Chertsey, a farmer put 150 half-grown fowls into a waggon, which was drawn into the middle of a cankered field, and turned them loose, when they soon annihilated the caterpillars; and they rendered the same services on the adjoining farm immediately after. Even when a part of the field has been all but destroyed, the introduction of ducks has speedily changed its appearance; the sooner, however, this useful operation commences the better; the farmer should therefore be on the watch for the young caterpillar, and immediately set his ducks and poultry to do their duty. Nearly 400 ducks were at work at one time on two farms in Norfolk, and saved all the crops intrusted to their care. When such large numbers are employed, they ought to be formed into detachments of not more than 100, and each must be attended by a boy or a girl, to precede them with a long light pole or willow rod, to brush the caterpillars off the leaves, as well as to drive the birds to water and to rest three or four times a-day; after drinking, the ducks will often disgorge the caterpillars in great quantities, and soon go to work again with whetted appetites: they must also be driven home at night, and put in a barn, where they ought to be fed with a little barley or other grain, to keep them in health and vigour, otherwise so much living animal food disagrees with them, and causes purging. Old ducks do not work well; select, therefore, those that are from three to five weeks old. Mr. Sells recommends that, after ducks and fowls have been made to fast a few hours, they should be tried with the larvæ, either alone or mixed with barley, by which means they would become acquainted with the insect to be sought for, and probably take a predilection for it.

I must not omit to state that Mr. Porter, of Covehithe, in Suffolk, derived great benefit from driving a flock of sheep over those turnip fields which were infested with the black caterpillar.

Having now discussed the various methods that have been adopted to arrest the ravages of the black caterpillar, we wish to impress upon the agriculturist that to be successful in any plan of extirpation, whether it regards the black caterpillar, when he again visits our turnip fields, or any other insect which ravages them every year, it must be resolutely persevered in, and above all things applied in good time. If we be dilatory or procrastinating, what chance have we in coping with an active enemy, which on the coast of Norfolk appeared in such myriads that the plants were stripped in a few days, so that it was too late when the blacks made their appearance to apply a remedy? And this proves how essential it is to be able to recognize the *saw-fly*, in order to be on our guard, and prepare at once for the worst. With this object in view, I have endeavoured to render the engravings as intelligible and complete as possible; and as a summary of the foregoing details will be useful for reference, I shall proceed to lay it before the reader.

It has been shown in the first chapter that the turnip-fly (*Altica nemorum*) is only to be dreaded in its perfect or beetle state; but it is quite otherwise with the turnip saw-fly, the caterpillar or larva of which is the only state in which it is capable of doing any mischief.

The *turnip saw-fly* is called by scientific men *Athalia spinarum*, and also *Tenthredo centifoliæ*. These flies *come over* from the north of Europe, but are probably bred in small numbers annually in England.

In 1756 their first appearance was recorded.

Their *mischievous visits* are at extremely irregular intervals.

In 1782, many thousands of acres were entirely destroyed in the county of Norfolk by the black caterpillar.

Subsequently to 1782, the year 1835 has proved the most fatal to the turnip crops from their attacks, the produce of a second and third sowing being destroyed by the black caterpillars.

In *July*, *August*, and *September*, the saw-flies are most abundant; but they have been found as early as the 29th of March, and as late as the middle of October.

The *male saw-flies* are the smallest, and hatch first; they are supposed to be most abundant, but my experience leads to an opposite conclusion.

On being touched they *feign death;* and are torpid in moist and cloudy weather, but very active in the sunshine.

They *rest* by night on plants and flowers, and *feed* upon the pollen.

They seem to *fly* against the wind, like the turnip-beetles.

Watering the plants as soon as the saw-flies appear would in all probability preserve the crop.

Scattering finely-powdered *salt* over the turnips when they are wet would keep the females from depositing their eggs.

The *eggs* are laid immediately after paring, between the cuticles of the leaf, close to the margin, or in the edge of a large hole, and are deposited singly in cells.

Outside *rough leaves* are selected for this purpose; and the leaflets at the base are often preferred.

The turnip saw-flies *live* twelve or fourteen days, and the females are exceedingly tenacious of life.

A female will lay from 250 to 300 eggs; and they hatch in from five to eleven days.

The *black caterpillars* are about one-tenth of an inch long at first, but three-quarters, and sometimes nearly an inch in length when arrived at maturity.

They *change their skins* thrice during their lives, which extend to nineteen days, or three weeks.

Previous to changing their first skin, they have the power of emitting a thread from their mouths, and are difficult to shake off: after the first moult they fall down on the slightest touch, and lie curled up.

If the *caterpillars* be disturbed whilst *moulting* they die.

They *descend* into the earth and there form a cocoon, in which they change to pupæ, often lying in the ground the whole winter; but in summer the saw-flies hatch in three weeks.

When they descend into the *earth,* if it be *fresh and moist,* it is better suited to their economy than when it is very dry.

Light soils seem to suit them best.

Swedes by the side of white turnips often not touched: in other instances they have suffered equally.

Swedes more or less infested, but not a caterpillar to be seen on the English turnips.

The *young larvæ* are *fastidious;* and when feeding on an old leaf do not relish a young one.

They are most *voracious* immediately after changing their skins; and when nearly full-grown do the most mischief.

They do not appear *simultaneously;* and there are often three broods in a year.

A *thunder-storm* destroyed myriads of the black caterpillars.

Cold checks their progress, and often kills them; and *wet* causes diarrhœa, which carries off great numbers.

Checked and destroyed in the ground by the *frost* of January, 1838.

Sometimes attack fields in *patches;* at others commence on one side, going regularly forward; and again leaving, perhaps, a space in the middle and all the borders untouched.

Large and *open fields* more liable to be attacked than small and inclosed ones.

Rooks and swallows are very serviceable in thinning their ranks; the former feeding on the caterpillars, the latter upon the saw-flies.

The caterpillars seem to be nearly free from *parasitic enemies.*

The *strewing of quick-lime*, coal-ashes, and soot, has been attended with various success, and generally with beneficial results.

Repeated *rolling* has killed and checked the caterpillars; but its effects are partial.

Hoeing an attacked crop the most fatal experiment, until all the caterpillars have disappeared.

Drawing a *cart-rope* over the turnips to shake off the caterpillars has proved more or less effective, most so when a brush made of elder-boughs has been fastened to it.

An *axle-tree* with wheels, the former armed with *green furze,* drawn along the rows, wounds and destroys the larvæ, as will also a *bushed hurdle.*

Brushing the larvæ off with *live twigs* and stamping upon them, a man following with a *scuffler,* has cleared a field of the larvæ.

A *trench* judiciously cut will often preserve a portion of a field, or an adjoining one.

Hand-picking, when the larvæ are not excessively abundant, may be depended upon as a certain remedy; and when in great numbers they may be brushed into sieves.

Pigs will destroy the black caterpillars.

Ducks and poultry will devour them with avidity; and this seems to be the most easy and effectual method of extirpating the black caterpillars: the birds may either be carried or driven into the field, according to the distance.

Sheep driven over fields infested with the caterpillar have done essential service.

EXPLANATION OF PLATE B.

Fig. 1. The eggs of the turnip saw-fly deposited in the leaf.
Fig. 2. The larvæ or caterpillars feeding and at rest.
Fig. 2 *a*. One of the fore-legs magnified.
Fig. 3. The cocoon, open at one end, after the fly has emerged from it.
Fig. 4. The larva, as seen in the winter, when a cocoon is opened longitudinally.
Fig. 5. The pupa or nympha in a cocoon, opened longitudinally in the spring.
Fig. 6. The male turnip saw-fly, considerably magnified; the cross lines showing the exact natural dimensions of a living fly.
Fig. 7. The female fly, the size of nature; some specimens, however, are a little smaller.
Fig. 8. The head of a caterpillar, showing a front view of the face, which is highly magnified, as well as all the following figures:—
b, The minute eyes.
c, The short antennæ.
d, The mouth.
Fig. 9. The various organs of the mouth of the caterpillar separated:—
e, The labrum or upper-lip.
f, One of the mandibles or teeth.
g, One of the maxillæ or jaws.
*, The pectinated or comb-like lobe.
h, The maxillary palpus or feeler.
i, The mentum or chin.
k, The labium or under-lip.
l, The two labial palpi or feelers.
Fig. 10. The various organs of the mouth of the fly separated:—
m, The labrum or upper-lip.
n, The two mandibles or teeth.
o, The maxillæ or jaws, uniting at their base.
p, The maxillary palpi or feelers.
q, The mentum or chin.
r, The labium or under-lip.
s, The labial palpi or feelers.
Fig. 11. One of the antennæ.
Fig. 12. Abdomen of the male, viewed beneath.
Fig. 13. Abdomen of the female, viewed beneath.
t, The valves and ovipositor.
Fig. 14. The same forcibly separated.
Fig. 15. Lateral view of the abdomen of a female.
u, The valves and ovipositor in profile.
Fig. 16. One of the valves detached
Fig. 17. One of the outer lancets
Fig. 18. One of the inner lancets.
Fig. 19. One of the fore-legs:—
v, The thigh attached to the trochanters and coxa.
w, The tibia or shank.
x, The five-jointed foot or tarsus.
y, One of the four suckers.
z, The two claws and pulvillus.
Fig. 20. The under side of a turnip-leaf.

All the figures are drawn from nature.

TURNIP CROPS.

The Turnip saw flies with their black caterpillars called Niggers

CHAPTER III.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE TURNIP CROPS; INCLUDING THE PLANT-LICE, MAGGOTS OF FLIES, CATERPILLARS OF MOTHS, ETC.

HAVING detailed the economy and natural history of two of the most formidable enemies to the turnip crops, I shall proceed to the investigation of some others which attack the foliage, and leave for a future chapter those which assail the roots. Some of them may at first appear to be of little consequence, as affecting the property of the farmer; but as we know that it is only from the excess of insects that serious mischief arises, and as it is far from improbable that they may all have their destined periods of appearance, to ravage our crops with fearful force, none of them ought to be neglected: for these reasons it will be advisable to make all the insects connected with farming known to the agriculturist; and I hope that the thirst for knowledge which is so natural to man, will tend to render my investigations acceptable. Let it likewise ever be borne in mind that whatever God has created is deserving of our attention, and the more we study His works the more convinced shall we be of the wisdom they manifest.

HISTORY OF THE APHIDES, OR PLANT-LICE.

There is no tribe of insects so universally distributed, or exceeding in multitudes the plant-lice; and, of all the animals that are destined to torment the gardener, none are more successful than the aphides, and the agriculturist not unfrequently suffers from the effects of their blighting powers, for probably there is not a plant, from the smallest grass to the most stately tree, that is altogether exempt from the visits of this pigmy—

> "Feeble race! yet oft
> The sacred sons of vengeance, on whose course
> Corrosive famine waits, and kills the year." *

The immortal Linnæus, considering that every plant supported a distinct species of Aphis, named these insects after the vegetables they fed upon; and similar as they may appear to a careless observer, I am induced, from an extensive and careful examination of this subject, to subscribe generally to the opinion of the Swedish naturalist; indeed, as far as the turnip is concerned, there are three, if not four species of plant-lice that are attached to the different varieties of this invaluable crop—two or three living upon the leaves, the other infesting the flower-stalks of those left for seed: one is exceedingly like those which attack the cabbages,* and I believe they are identical; if such be the case, it may be admitted as an exception to a general rule, but it must be remembered that it is the Swedes which this species infests.

We have in a former chapter alluded to the remarkable economy of the aphides, which during the summer bring forth young without sexual intercourse, and in the autumn lay eggs; the fecundation of the first female being sufficient to render twenty successive generations fertile.† No writer that I am aware of has paid particular attention to the turnip aphides, although the leaves are often infested to a great extent towards the end of summer, as well as in the autumn, and by their piercing the nerves the leaves become curled and distorted, at the same time affording the insects a habitation, protected both from heat, wet, and cold: the green tops thus become less serviceable as food for cattle, and the growth of the roots is unquestionably retarded by the exhaustion of the leaves, and the outer ones, turning yellow, fall off. They are sometimes attacked at a much earlier period; for Mr. Marshall observed the aphides extremely numerous on *seedling* leaves, from whence he concludes that they may be the cause of the very slow progress which is sometimes made by the young turnip plants to push into *rough-leaf*.

I wished to watch the economy of these insects, and having sown some turnip-seed in a garden in the spring, I found the leaves infested with the aphides in the middle of July, when the wingless females (No. 4, fig. 7; 8, magnified),‡ were surrounded by their young broods, unmolested by the heavy rains which had incessantly fallen during the previous fortnight; and two winged ones were sheltered in the same situation (fig. 5; 6, magnified). On the under side of one small leaf I counted 168 aphides; they comprised about a dozen large green ones, like figs. 7 and 8, one of which was just

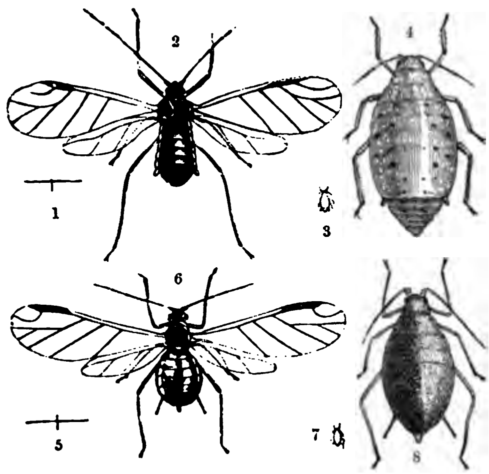
* Mr. F. Walker says, "Two distinct species infest the turnip; the one is bright pale red in colour, the other green, covered with white down, which is also abundant on the cabbage."—See *The Entomologist*, p. 173.

† M. Bonnet, who first tried the experiment, thinks that aphides would produce in this way to the thirtieth generation.

‡ All the lines and cross-lines denote the natural dimensions of the magnified figures throughout this volume.

giving birth to a young aphis; apparently, to me, it was inclosed in a thin membrane, and came forth backwards, which would render its inclusion in a sac the more necessary; it was exactly like a pupa, with two little black eyes shining through, and the antennæ were folded backward, as well as the legs, so that the limbs were not free, but the instant it was perfectly excluded it began to move its horns, and immediately afterwards used its legs.* The females are green, and finely shagreened; most of them were surrounded by eight or ten young ones of a yellower colour, and there was a considerable number of larger young ones, of a somewhat rosy tint. I likewise observed eight dark specimens, each of which was accompanied by five or six young ones, of a similar colour, with two dark oval spots upon the head; and these, I am inclined to believe, belonged to a different species.

No. 4.



It may readily be conceived that, under favourable conditions of the atmosphere, the multiplication of the aphides must be beyond calculation: in 1827 and 1836 they are stated to have committed very extensive ravages on the turnip crops.† In the absence, however, of any positive data immediately connected with the natural history of the turnip aphides, I shall avail myself of information relating to kindred species, which will equally well illustrate the habits and economy of this family, and supply us with the means of studying any of its members.‡ Most of the plant-lice, I believe, come forth in the spring, as soon as the foliage is apparent, but some are seen even before the leaves are expanded: at this time they are all wingless females, which have hatched from eggs that had been laid the foregoing autumn: these soon disperse, and forcing their rostrums up to the base in the tender stalks and leaves of plants, begin to produce young in ten or twelve

* Mr. W. Curtis says that the young of *A. salicis* were able to use their legs before they were perfectly disengaged from their mother, and thus assisted in liberating themselves.—*Linnean Transactions*, vol. vi. p. 79.

† In 1793 the aphides were the chief, and in 1798 the sole cause of the failure of the crops of hops.—W. Curtis, *Linnean Transactions*, vol. vi. p. 79.

‡ Schmidberger, in Kollar's *Naturgeschichte der schaedlichen Insecten:* see *Aphis pyri, mali, pruni*, and *persicæ*, p. 291.

days, which likewise seem to be wingless females; and as no males make their appearance until the autumn, when pairing takes place, it is evident that the females must be pregnant at their birth, without sexual intercourse; and this occurs for several successive generations. The females produce about two young ones daily during fifteen or twenty days;* and Kollar says that, in ten days, the third generation from the eggs is able to bring forth young, comprising winged as well as wingless females, the former flying away as soon as they have arrived at maturity, and the latter remaining on the plant where they were produced. Both the winged and wingless females of the third generation are able to produce young in eight, and even in four days, which are capable of the same power as their parent at the expiration of a similar space of time; and proceeding thus until the middle of September, the generations often amount to sixteen or twenty—thus, from one egg only, 729,000,000 aphides would be produced in seven generations, taking thirty as the average of each brood—twenty being the minimum, and forty the maximum;† so that if they all lived, everything on the face of the earth would be covered with them. About the middle of September, the last generation, consisting of males and females, is produced; the former generally becoming winged. When they have attained maturity, the sexes pair, and the females no longer bring forth young, but lay eggs, which are able to resist the severity of winter, and these, hatching in the succeeding spring, again produce viviparous mothers. The autumnal stock, having provided for the continuation of its race in the following year, generally dies off before the approach of winter.

Towards the end of March, or the beginning of April, we often have a succession of cold drying winds, from the north and north-east, at which time the aphides occasionally make their appearance so suddenly as to be termed a blight: these must be the offspring of the autumnal eggs, or broods which had lived through the winter. Their increase in damp and sultry weather, at a more advanced period, is equally surprising; and the universal diffusion of such myriads, soon after a thunder-storm, has led, as with the black caterpillars, to the vulgar error of their having fallen from the clouds. Electricity probably causes the simultaneous appearance of insects in many instances, for the irritability of the nervous system is excited by the increased action of oxygen, so that insects, both in the egg

* On opening the body of a willow aphis, Mr. W. Curtis counted sixty-one young ones, large and small, and in another forty-six.

† Reaumur (vol. vi. p. 566) has proved that, in five generations, one aphis may be the progenitor of 5,904,900,000 descendants; and it is supposed that, in one year, there may be twenty generations. —See Kirby and Spence's *Introduction to Entomology*, vol. i. p. 174.

and pupa states, may be more speedily developed, the dormant eggs may thus be called instantly into life, and the viviparous aphides bring forth their young simultaneously; which may, in some measure, account for the vast swarms of plant-lice that so frequently cover, in a few hours, the flowers in our gardens and the crops in our fields.

I have already stated, that there are three, if not four species of aphides which live upon the turnips: the first (figs. 6 and 8) I have found under the rough leaves of the English varieties, as well as one which I believed to be distinct; another (No. 5, figs. 2 and 4) appears to be attached to the Swedes; and the last (No. 4, figs. 2 and 4) is secreted amongst the flower-stalks. During the first few generations they are all wingless, but as the summer advances they appear to arrive at greater perfection, and assume a more complete state of development; so that, eventually, individuals of both sexes are furnished with wings, when they are capable of doing incredible mischief by the extended field of their operations; for, flying about, they form colonies in every direction, and they are thus enabled to select a proper nidus for the eggs, which are laid by the last generation in the autumn, after the pairing of the sexes. The aphides generally deposit their eggs, which are hard, and like parchment, in the most secure places, under the buds, in the forks of branches of trees, &c., and sometimes, it appears, upon the leaves.*

The young are furnished with horns and legs, like their parents, but they are generally narrower in proportion, and often of a different colour. Like most insects in their growing state, they change their skins several times, which are left sticking to the plants on which they live; and they are never deprived, from their birth to their adult state, of the power of locomotion, as the turnip-beetles and turnip saw-flies are, which lie quiescent in their pupa state. The aphides belong also to an order which we have not before noticed, called HOMOPTERA, but it formed a section only of Linnæus's order *Hemiptera:* the family is named APHIDIDÆ, containing, amongst other groups, an extensive genus called APHIS.

This genus† has two horns, considerably longer than the body, often as long as the wings, naked and tapering like bristles, inserted in front of the face, composed of seven joints, of which the two first are short and oblong, the following long, especially the third. Rostrum bent under the breast, short, and four-jointed; longest in the females. Eyes globose and lateral; ocelli, or simple eyes, three, very remote. Collar of thorax very long in the

* Mr. W. Curtis saw several small irregular groups of eggs of an aphis, which were deposited on both sides of the leaves of some auricula plants, in November.

† Curtis's *British Entomology*, fol. and Plate 577.

males. Abdomen ovate-conical in the males, with two tubes on the fifth segment. Wings four, transparent, deflexed in repose; superior twice as long as the body, ample, with several nervures, the furcate apical cells short: inferior wings much smaller, with a nervure forming three rays. Females generally apterous; the bodies stouter. Legs six, long and slender, especially the hinder pair: thighs long; shanks longer; feet short, composed of two joints, the first scarcely visible, terminated by two curved acute claws.

The different species already alluded to I will now proceed to describe:—

1. *Aphis rapæ*, Curtis*—the turnip-leaf plant-louse.

Male—ochraceous; horns moderately long, setaceous, fuscous, two first joints black, third ochreous at the base: head blackish, collar ochreous and brown, disk of thorax shining black; abdomen greenish, the spiracles or breathing pores brown: tubes long, slender, ochreous at the tip; the apical process of the body ochreous also: wings iridescent, the nervures light brown: stigmatic spot long and yellowish; apical cell somewhat oval; furcate cells elongate-trigonate; terminal one short: tips of thighs, shanks, feet, and claws, black (No. 4, fig. 5; 6, magnified). *Female*—bright green, shagreened: horns fuscous, except at the base: eyes, tips of shanks, and feet, black (fig. 7; 8, magnified).

Abundant beneath the leaves of the English turnip the whole of July, &c. It is at once distinguished from the other species by its long tubes and small apical cells of the wings.

During the summer and autumn of 1842, between 500 and 600 acres of turnips were totally destroyed by the aphides, in the neighbourhood of Alnwick and Wooler.—(See *Zoologist*, vol. i. p. 123.)

And in 1854, *Aphis rumicis* was exceedingly abundant everywhere, and destroyed the turnip crops to a great extent in Yorkshire, as stated in a communication from Mr. Lister.

2. *Aphis dubia*, Curtis—the black-spotted turnip-leaf plant-louse.

Female?—dull darkish green, shagreened: antennæ shortish, third joint ochreous, the following fuscous: rostrum short and stout: eyes, ocelli, and two large patches on the collar, black: each segment of the abdomen has a more or less complete transverse black stripe, interrupted down the middle; the tubes are slender and longish; the tail is banded with black, and the conical apex is of the same colour: legs ochreous; tips of thighs, tibiæ, and the tarsi, fuscous.

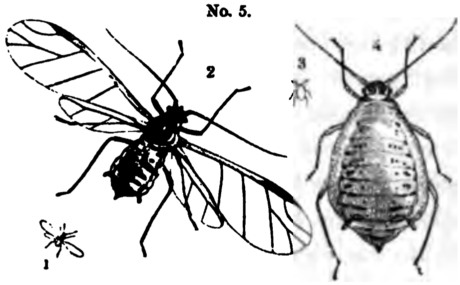
Found, the end of July, beneath the turnip-leaves, with the former species.

* Curtis's *Guide to an Arrangement of British Insects*, Genus 1047, 18 *b*.

3. *Aphis brassicæ*, Linnæus—the cabbage and Swedish turnip-leaf plant-louse.

Male—generally pea-green: horns setaceous, longish, and black; as well as the head, collar, and disk of thorax: several blackish bands, more or less perfect, across the body: tubes short and stoutish, black at the base: wings iridescent, stigma pale-green, nervures strong, piceous, apical cell large, and the first furcate one wider than in *A. rapæ:* legs black, base of thighs green (No. 5, fig. 1; 2, magnified). *Female*—slightly mealy, generally of a yellower green than the males: third joint of antennæ ochreous, following black: eyes, two large spots on the crown, and one on each side of the collar, black: abdomen very large and heavy: spiracles, several dots upon the back, and a few transverse streaks beyond the middle, black: tubes short and black, as well as the legs; base of thighs, greenish (fig. 3; 4, magnified).

No. 5.



As far as my own observation goes, the Swedes have suffered most from the aphides; the under sides of the curled leaves being sometimes densely covered with them, of all sizes. The old wingless females are seen resting in August, September, and October, surrounded by their young broods, with here and there a winged male walking lazily over his kindred. The leaves are frequently at the same time gray with mildew; but that is a distinct disease.* I may observe that I have seen myriads of *Aphis brassicæ* under cabbage leaves in July, and secreted in the leaves of the crumpled broccoli as late as the end of November, when they were of all ages and sizes, both winged and apterous.

4. *Aphis floris-rapæ*, Curtis—the turnip-flower plant-louse.

Male—dull pale-green, dusted with white: antennæ moderately long, blackish, excepting the base of the third joint: eyes, head, disk of the thorax, and abdomen, varied with black; tubes short and barrel-shaped: wings similar to those of *A. brassicæ:* legs ochraceous; apex of thighs, shanks, and feet, black (No. 4, fig. 1; 2, magnified). *Female*—dull pale pea-green, powdered with white: rostrum short and stout: eyes black; antennæ rather short, slightly hairy, terminal half brownish: abdomen, with

* It is said that, in a very dry autumn, early sown turnips seldom escape the mildew, which is a species of fungus, forming a whitish powder over the leaves, and readily brushing off; the leaves thus affected soon become yellow, dry, and brittle: and at an early stage this disease seems to encourage the aphides, owing to the plants not being healthy and able to resist such attacks.

Their method of attacking the aphides is curious. I have seen one of these struggling whilst this little insect alligator threw his fore-legs about it, and was greatly amused at the skill it exhibited; for, fearing that the aphis might escape, it gradually slid along to the wings, which were closed, and immediately began to bite them, so that in a very short time they were rendered useless, being matted together: it then returned in triumph to the side of its helpless victim, and seizing the thorax firmly in its grasp, it ate into the side, coolly putting its hind-leg over those of the aphis, whose convulsive throbs annoyed its relentless enemy. These larvæ are full grown in about a fortnight or three weeks, when they are from a quarter to a third of an inch long and upwards; they are then slate-coloured and yellow, with numerous black spots and hairy tubercles down the back, intermixed with a few scarlet spots (fig. 3, magnified). They soon retire to a leaf, or some secure locality, and, attaching themselves by the tail, change to pupæ (figs. 5 and 6) of a shining black colour, with a row of orange spots down the back: thus they remain during another fortnight or three weeks, when the inmate bursts through her cell, and appears again a perfect lady-bird.

No. 6.

Attracted by the swarms of aphides in the hop gardens, they sometimes congregate in myriads; and having regaled themselves and deposited their eggs upon the plants, they wing their way in large companies, often to perish on our shores in the autumn,* or to disperse themselves over our turnip and corn fields, where we often see their scarlet jackets sparkling upon the bright green leaves. These beetles belong to the order COLEOPTERA, and to the family COCCINELLIDÆ, and form the genus COCCINELLA of Linnæus. There are two species which seem from their numbers to be most beneficial to man.

5. *Coccinella bipunctata*, Linn.—The two-spotted lady-bird is convex and black, excepting the scarlet wing-cases, and on the centre of each of them is a black dot; at the inside of the eyes there is a cream-coloured spot, and a larger one on each side of the thorax, with two minute dots uniting at the base, of the same colour (fig. 7). This insect is so variable in colour, and the individuals are so very dissimilar, that it is called *Coccinella dispar*

* In 1807, the shore at Brighton, and all the watering places on the south coast, was literally covered with them.—Kirby and Spence's *Introduction to Entomology*, vol. i. p. 258.

by many authors, some specimens being black, with a large red patch on each shoulder, and a round spot of the same colour on each wing-case, with the margin only of the eyes and of the thorax whitish; and between these extreme varieties will be found every gradation from red to black; they are all about 2¼ lines long (fig. 8).

6. *C. septempunctata*, Linn.—The seven-spotted lady-bird is larger, very convex, being hemispherical, black, with bright brick-red wing-cases, having a large black spot in the centre of the base, with three smaller dots on each, forming a triangle: there are two cream-coloured dots at the base of the head, and a large one at each of the anterior angles of the thorax (fig. 9). It is more than 3¼ lines long, and nearly 3 broad, and varies but little, the spots sometimes being smaller than in our figure, and rarely vanishing.

The next, perhaps, in importance amongst the parasites is a diminutive fly, which hovers about plants infested by the aphides; and the female soon settling amongst them, begins to examine the herd with her vibrating horns, and having fixed on a female aphis, which is not already punctured, she bends down the apex of her body, and pierces the insect with her ovipositor, which is invisible to the naked eye: she then proceeds to another, depositing a single egg in each, and thus daily inoculates a considerable number. As the aphis imbibes the juice of the plant, the little maggot which has hatched in her body hourly increases in size, growing with her growth, until the exhausted aphis dies, leaving its horny, shining, and inflated skin sticking by its rostrum and legs to the plant, looking like a little tawny pearl: the parasite then changes to a pupa, and, having completed its various transformations, it becomes a perfect fly in about eight days, and eats through the side of its cell, often leaving a round lid attached and open like a door.

These insects belong to the order HYMENOPTERA, of the family ICHNEUMONIDES ADSCITI, and were described by Linnæus under the name of *Ichneumon aphidum*. The species I have bred from the turnip aphides is now described as—

7. *Aphidius* (*Trionyx*) *rapæ*, Curtis.*—Antennæ shorter than the body, composed of fourteen joints, basal joint beneath, as well as the mouth, ochreous; head and thorax shining black; abdomen spindle-shaped and pitchy in colour, attached to the trunk by a narrow ochreous petiole; wings four, iridescent; superior, with a narrow fuscous stigma, from which issues beneath a short curved nervure, and there is a large elongate-trigonate

* Curtis's *British Entomology*, Plate 383, and the *Guide*, Gen. 562 *b* and 547, where fifty-four British species of *Aphidii* are recorded, forming the subgenera *Praon*, *Ephedrus Toxares*, *Monoctonus*, *Trionyx*, and *Aphidius* of Haliday.

cell at the base; legs, six, slender and bright ochreous, variegated with dark brown; length, 1¼ line; expanse of wings, 2½.

As there are many generations of these flies in a summer, it follows that they are most formidable enemies to the plant-lice; and Providence, watchful of all his works, and regarding in the smallest as well as the greatest that balance which preserves the order of the universe, to avert the total annihilation of the feeble aphides, has provided numerous other parasitic flies to destroy the destroyers, and again keep them in check. The aphidii are such constant attendants upon infested plants, that I scarcely ever notice any unaccompanied by the horny shells of the defunct plant-lice; and even in a green-house I have seen nearly as many of these parasites as there were of the aphides.*

It is impossible to advance a step in the natural history of insects without finding so much to interest and admire, that it is difficult to refrain from entering fully into the subject: fearing, however, that I may become tiresome to the general reader, I will allude as briefly as possible to the little flies which destroy the maggots of the full-fed aphidii, glutted with the vitals of the plant-lice; they are all hymenoptera; and whilst they fly about to reconnoitre the aphides, no sooner have they met with one that contains a maggot than they pierce the already indurated shell, and deposit an egg within: as soon as it hatches, it commences feeding upon the parasitic maggot, or more probably on the quiescent pupa; and instead of an aphidius, one of the following insects bursts from its dark tomb, namely, *Ceraphron Carpenteri*, *Asaphes vulgaris*, and *Coruna clavata*.†

8. *Ceraphron* (*Megaspilus*) *Carpenteri*, Curtis.‡—Black, head and thorax pubescent; body shining; horns long in the male, and eleven-jointed, the joints hairy, and more or less serrated, excepting the two first and the last; simply clavate in the female; wings, four, with a large brown semi-orbicular stigma on the superior, from which issues a short curved nervure, being the only one; legs pitch-colour, apex of thighs, the shanks and feet ochreous; length, two-thirds of a line; expanse, 1⅔.

I have frequently bred this insect from aphides, containing, no doubt, the parasitic aphidii.

9. *Asaphes vulgaris*, Walker.§—*Female* with clavate black horns, com-

* During the end of July and beginning of August, 1848, scarcely a female *Aphis brassicæ* escaped out of the swarms under my cabbage-leaves. They produced the *Trionyx rapæ* and *Cynips fulviceps*, and the same, or a closely allied species, infests the carrot aphides at an earlier period.—J. C.

† *Entomological Magazine*, vol. i. p. 380.

‡ Curtis's *British Entomology*, fol. 249, and *Guide*, Gen. 581, 7.

§ *Entomological Magazine*, vol. ii. p. 151; Curtis's *Guide*, Gen. 625, 1.

posed of thirteen joints; head and thorax bright green, shagreened; abdomen short, ovate, pointed, very glossy bottle-green; wings nerveless, excepting a single nervure near the anterior margin of the superior, which forms a little clavate branch beyond the middle; legs pitch-colour, nearly 1 line long and 2 broad.

10. *Coruna clavata*, Curtis.*—Horns pale brown, hairy, thirteen-jointed in the male, twelve-jointed in the female, basal joint ochreous, apical joint lance-shaped; head and thorax shining bluish-green; abdomen sometimes more yellow-green, very glossy, depressed, clavate; wings similar to the last, but the button of the nervure is larger; legs ochreous; hinder thighs brownish at the middle; length, ¾ line; expanse, 1¾.

Both the above insects belong to the family CHALCIDIDÆ. I have bred the last from the indurated skins of the aphides which had been infested by the aphidii. When touched, this fly skips about.

It is not a little remarkable that some of the *Cynipidæ* or gall-flies, which form the "oak-apples," "Robin's pincushions," &c., prey in the same way upon the plant-lice, leaving their horny skins sticking to the leaves on which they fed. Amongst them I shall describe two only from my own collection.

11. *Cynips quercus-inferus?* Linnæus.†—Pitch-colour, shining; head and thorax rugose; horns and mouth bright rust-colour; the former composed of fourteen joints; wings iridescent, with the nervures pale reddish-brown, having an elongate-trigonate cell on the margin, with an indistinct minute areolet at its inner angle; legs ochreous; length, 1½ line; expanse, 3 lines.

This was bred from aphides by the late Mr. T. Carpenter.

12. *Cynips fulviceps*, Curtis.‡—Glossy black; horns longish; thirteen-jointed; fuscous, ochreous at the base; head and legs bright ochreous; wings iridescent; nervures bright brown; areolet none; length, ½ line; expanse, nearly 2 lines.

I have bred several of this pretty species from cabbage aphides, in the end of July and beginning of August; and Jurine has figured another in his *Hyménoptères*, of the same habits, called by him *C. erythrocephalus*, Plate xii. Gen. 40.

We will now return to the insects which destroy the aphides, amongst which are some larger species of hymenopterous flies, belonging to the family of CRABRONIDÆ, which it is necessary to notice and describe here.§

* *Guide*, Gen. 632 *a*.

† Ibid. Gen. 564, 14.

‡ *British Entomology*, Plate and fol. 688; *Guide*, Gen. 564, 27.

§ Those who wish to identify these insects with greater certainty, must consult the plates and descriptions referred to.

13. *Trypoxylon figulus*, Linn.*—is shining black, clothed with silky whitish pubescence; the horns are short and thirteen-jointed in the males, twelve-jointed in the females; the body is rather long, forming a club, being slender at the base, and the edges of four of the segments are hoary; the four wings are dusky at their extremities; and the brown nervures form six distinct cells in the superior: it varies in size from a quarter to half an inch in length, and the wings expand from 5 to 8 lines, or nearly three-fourths of an inch.

These insects are abundant upon old posts, palings, or out-houses, gates, barns, stable-doors, &c., in which they form burrows to deposit their eggs, from the middle of May to the end of summer: it appears that they collect masses of aphides, probably to feed their young, which also subsist upon dead spiders, carried into the nests by the parent flies.

14. *Pemphredon* or *Cemonus unicolor*, Lat.†—Black, shining, clothed with grayish hairs; head large, nose silvery; horns short, curved, thirteen-jointed in the males, twelve-jointed in the females; head and thorax punctured; body oval, pointed, and attached to the trunk by a narrow neck; wings, four; iridescent but smoky, superior with eleven cells, formed by blackish nervures; length, ¼ inch; expanse, 5 lines.

This, as well as a larger species, called *Pemphredon lugubris* of Fabricius, may be seen during the summer months, carrying immense quantities of aphides into straws in thatch, and holes in wood, posts, &c., to feed their young maggots upon. The following species, and likewise an allied one, have similar habits.‡

5. *Diodontus gracilis*, Curtis.§—Smaller and more slender than *Pemphredon*, to which it is nearly related, but is distinguished by its notched upper lip: it is black and shining; the head and thorax are punctured; lower part of face clothed with silvery hairs in the males; the four feelers and a stripe outside of the jaws yellowish-white; the body is elliptical and pointed, attached to the thorax by a short neck; wings transparent; nervures and stigma pitchy; tips of thighs, base and tips of shanks and the feet ochreous, excepting the hinder pair; length, ¼ inch; expanse, 4 lines.

16. *Psen atratus*, Panz.‖—Black, shining; antennæ thirteen-jointed, curved in the female, rusty beneath, especially in the males; face silvery

* Curtis's *British Entomology*, fol. and Plate 652; and *Guide*, Gen. 682, 1.

† Curtis's *British Entomology*, Plate and fol. 632; and Kennedy, in *London and Edinburgh Philosophical Magazine*, January, 1837, p. 18.

‡ *Diodontus corniger*, Shuck., and *Philosophical Magazine*, January, 1837, p. 17.

§ Curtis's *British Entomology*, Plate and fol. 496; *Guide*, Gen. 687 *b*, 5.

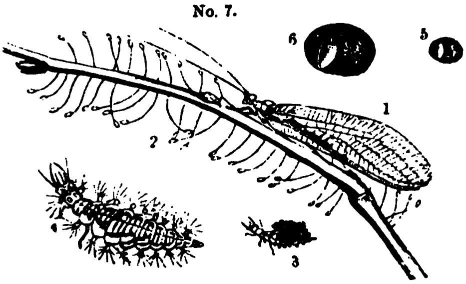
‖ Curtis's *British Entomology*, second edition, fol. and Plate 25; *Guide*, Gen. 691, 2.

with hairs; head and thorax finely punctured; body ovate, conical at the apex, attached by a short slender neck at the base; wings four, transparent, beautifully iridescent, the nervures and stigma blackish; fore shanks and feet sometimes ochreous; length, 2½ lines; expanse, 4¾.

Mr. A. Kennedy observed the males of this species flying about the thatch of a summer-house and the neighbouring shrubs, at Clapton, in thousands, at the beginning of July, and the females became numerous about the 10th; they employed the open straws of the thatch to deposit their prey in, which amounted to 100 aphides in a single straw, containing cells with partitions made apparently of the scrapings of the inside of the straw cemented together. The eggs deposited in them by the *Psen* are white and semi-transparent, and are attached to the abdomen of an aphis near the bottom of a cell.* I bred these flies likewise from straws out of the roof of a summer-house at Bristol, in the end of June.

We now come to a set of insects, which, like the lady-birds, begin to feed upon the aphides as soon as they escape from the egg, and from that time are constantly hunting after them, until they change to beautiful flies, one of which is called the *golden-eye*. These larvæ are ferocious little animals (No. 7, fig. 4), named by the French "*lions des pucerons*," or plant-lice lions. Some clothe themselves, like Hercules, with the skins of their victims (fig. 3), and others with the green and delicate lichens which cover old paling, and the trunks and arms of trees, so that unless the larvæ move, it is impossible to detect them; and thus, concealed from the prying search of the smaller birds, they lie in ambush for their prey; but when they are encamped upon a leaf, amongst the sluggish aphides, they seize them with their long and powerful jaws, and will devour the largest of them in half a minute. The food of this voracious larva, however, is not confined to the aphides; for two which I found at the end of August, on being placed in a box, immediately attacked each other, the conqueror making a meal of his companion, and soon after sucking the contents out of a caterpillar three-fourths of an inch long, leaving only their skins. These larvæ vary considerably in colour, being whitish or fuscous, with brown or orange spots, some having the sides of their bodies furnished with sixteen fleshy tubercles,

No. 7.



* *Philosophical Magazine*, January, 1837, p. 18.

producing a spreading bunch of hairs; they have a pair of slender horns, two long stout curved jaws, and a pair of long slender-jointed feelers; besides their six feet, the apex of the abdomen is prehensile, forming, as it were, a seventh foot, which has the power of adhering to very smooth substances. After feeding for fifteen or sixteen days, they spin a fine silken whitish cocoon (fig. 5; 6, magnified), which is often clothed with the bits of lichen which formed a shield to the larvæ; they vary from the size of pearl barley to a small pea, and are attached to leaves of plants, &c.; in these they change to a pupa, and in about three weeks the flies come forth in summer; but the autumnal ones remain through the winter in that torpid state. The case, it may be observed, is not spun from the mouth, as the silk-worm forms its cocoon, but from the apex of the body, similar to spiders; and it is astonishing, considering the very ample wings of some of the flies, how they can possibly be arranged in so small a space as they occupy in their little cells.

The flies are not long-lived, and the female deposits her eggs in a very remarkable way, in order to protect them from the attacks of parasitic and other insects. They are placed in groups of ten or twelve, on various parts of the leaves, stalks, &c., and so much resemble vegetable productions, that they have been mistaken for the capsules or seed-vessels of some moss. It appears that the female being supplied with a glutinous fluid in the ovary, she places the apex of her body to the edge of a leaf, and lifting it up, draws out a transparent thread, not thicker than a hair, sometimes to the length of an inch, the egg forming a little oval club at the tip (fig. 2). I think it extremely probable that they are deposited while the female is on the wing by an undulating flight, which brings her at intervals in contact with the leaf or object beneath her; but I believe no one has detected this insect in the act of depositing the eggs.

The flies which we are alluding to are included in an order called NEUROPTERA, of the family HEMEROBIDÆ, and constitute the Linnean genus HEMEROBIUS, which is now divided into four genera,* two of which, CHRYSOPA† of Leach, and HEMEROBIUS,‡ are the groups which produce the larvæ whose history we have just given. The former genus contains ten or twelve British species of beautiful flies, generally green, and well known by their prominent, splendid eyes, whence they are called with us *golden eyes*. They fly principally at night, and are heavy on the wing by day, so that they are easily caught; and on being touched they emit a most offensive odour. I will now describe the commonest species, which is named by Linnæus.

17. *C. perla.*—It is a palish green; the horns are slender, as long as the

* Curtis's *Guide*, Gen. 739, 740, 740 *b*, and 741.

† Curtis's *British Entomology*, fol. and Plate 520.

‡ Ibid. 202.

body, and composed of numerous small joints; the eyes very prominent, golden-green; body moderately long; wings four, deflexed in repose, twice as long as the body, transparent but greenish, reflecting the most beautiful rose-colour and rich yellow, reticulated with innumerable hairy nervures, the transverse ones blackish near the base; legs six, very short and slender. Male, 4 lines long; wings expanding 1¼ inch: female, ½ inch long, expanding nearly 1¾ inch (fig. 1).

This species is common about hedges, fields, gardens, and orchards in June, July, and August. In May, 1841, I found one of the larvæ: its back was clad with lichen, the skins of caterpillars in fragments, and apparently its excrement: it spun a white silken cocoon, of exceedingly fine texture, the beginning of June, to the outside of which adhered the materials already mentioned; and in a week or ten days after, I found in the box a fine specimen of the golden-eyed fly, of such dimensions that it appeared incredible it should have been produced from so small a pupa. A white transparent case or shroud, like those of the May-flies, was lying by it, showing that it had emerged as a pseud-imago.*

The other genus still retains the appellation of HEMEROBIUS, and is more extensive, comprising, it is supposed, upwards of thirty species. Their economy appears to be precisely the same as that of *Chrysopa;* for a larva which I found the end of September, 1841, was feeding upon aphides in company with the maggots of the Syrphidæ. It was of a bright yellow, with markings of a clear rust colour: it was very active, continually moving its head from side to side, and eventually produced a species named by the late Dr. Leach.

18. *H. obscurus.*—It is ochreous; the horns are rather longer than the body, slender, hairy, composed of numerous globose joints; eyes very prominent; head and trunk with a brown stripe on each side; abdomen of the same colour: wings nearly twice as long as the body, very much deflexed when at rest, slightly tinged with fuscous, but with a beautiful blue and rose-colour; superior, with numerous pilose nervures dotted with dark brown, having two irregular waved transverse lines of a pale brown colour beyond the middle; inferior wings of a lovely rose-colour, the margin alone iridescent and brownish: legs six, and rather short: about 3 lines long, and expanding 8.

These insects frequent every hedgerow and plantation, and from thence they fly by night into fields, meadows, gardens, &c., and they are sometimes plentiful in turnip fields. They are always very brisk and lively on the

* A state between the Nympha and the perfect insect or Imago.

approach of a thunder-storm; but when caught, they lie with their wings closed and compressed, and their horns and legs drawn up, as if they were dead, some of them looking, in that inanimate state, like dead leaves.

We shall close this account of the insects which feed upon aphides, by giving the history of the larvæ of several flies called *Syrphi*, which appear to be more numerous than the lady-birds or the aphis-lions, and, being very expert, they cause greater havoc amongst the plant-lice than probably any of those already recorded. The parent flies are so numerous, as to be, in a great measure, the cause, I believe, of the incessant vibration of the air or buzzing which we hear in the country in fine, still, sunny days in the summer and autumn months: they belong to an order called DIPTERA, and to the family SYRPHIDÆ, which is divided into several genera, and amongst them are SCÆVA* and CHEILOSIA, containing upwards of fifty species:† the larvæ of these are found during the spring, summer, and autumn, in company with those of the lady-birds: they are fat, fleshy maggots, sometimes green, at others yellow, variegated with orange; and their skins are so delicate, that the circulation of the fluids and the colour of the intestines are distinctly visible even to the naked eye. When the maggots first emerge from the egg, they are little inoffensive-looking creatures, scarcely visible, surrounded as they are by the indolent, helpless aphides, with their bleached, cast-off skins scattered over the leaves; but as soon as their appetites call them into action, they thrust out their heads and necks like leeches, fasten upon the nearest aphis, and holding it up in the air (No. 8, fig. 2), they suck out the contents of their victim with evident satisfaction. In this way one hungry maggot will devour 100 aphides in an hour: when satiated, he draws himself up, and lying close to the leaf, he enjoys his repose. Having grown to his full size, he attaches his tail to a leaf, tree, wall, or other object, and becomes a horny pupa in his own indurated skin, which assumes the shape of a pear, of a dull colour (fig. 3). Amongst the parent flies, the most conspicuous are—*Scæva Pyrastri*, *S. Ribesii*, *S. balteata*, and *Cheilosia scripta*, which I will characterize.

No. 8.

19. *S. Pyrastri*, Linn. (fig. 4)—is a large fly with two little black horns in front of its ochreous face, and two large copper-coloured eyes, nearly covering

* Curtis's *British Entomology*, fol. and Plate 509.

† Curtis's *Guide*, Gen. 1240 and 1241.

the whole head in the males, but not meeting on the crown in the females; the trunk and a lobe behind called the scutel are bottle-green, densely clothed with short, pale, velvety hairs; the body is similarly clothed, flat, of a good size and oval, deep black, with three long, yellowish spots on each side, curved, and nearly meeting on the back; the two last segments are edged with the same colour: it has only two wings, which are as clear as glass, but iridescent, with several fine brown nervures, forming long cells; just below their base, on each side, is a little clubbed process, of an ochreous colour, called a poiser; the six legs are pale rust-colour, the thighs black at the base, the hinder entirely black, excepting the tips; the feet, which are brown, have five joints each, they are terminated by two little claws and two lobes, called pulvilli; the fly is from ½ inch to 9 lines long, and expands from 1 inch to 13 lines.

This is a fly which is seen from June to the end of October hovering over wild and garden flowers in fine weather, and resting in cloudy days on trunks of trees and paling, with their wings closed and lying upon their backs. Some idea may be formed of the numbers of the larvæ, and the consequent benefit derived from their operations, when we state that on the 30th July, 1818, which was a very hot day, these flies were in such swarms that they quite covered the fishermen's boats at sea off Broadstairs, and they were equally abundant at Ramsgate and the Nore. When thus congregated, insects fly in one direction, not even avoiding objects that lie in their course; and in the above instance, it appears that they were bound to the hop gardens in Kent, where the crops often fail through the effects of the aphides, as we have already observed. The maggots of this species are green (fig. 5; fig. 6, the pupa), and I found them in July, 1829, in some abundance on the sea-cabbages, *Brassica oleracea*, which grow under the cliffs near Dover. Many of them had been stung by a little parasitic fly called *Microgaster lineola*,* the maggots of which came out of the Scæva larvæ, and formed little elliptical silken cocoons almost white.

20. *S. Ribesii*, Linn.—is a similar fly in form, but smaller; the head is yellowish, the nose horny and shining; eyes coppery; horns rust-colour, black above; trunk bottle-green, scutel yellow; body black, with a large yellow or orange spot on each side of the base, then follow two broad and two narrow bands; the legs are bright ochreous, the base of the thighs fuscous; wings the same as in *S. Pyrastri;* length, 5½ lines; expanse, 11 lines (fig. 7).

This fly is abundant everywhere in England in the summer, especially in July: it is equally common in Scotland and Ireland, where I have taken many specimens.

* Curtis's *Guide*, Gen. 554, 57, and *British Entomology*, fol. and Plate 321.

21. *S. balteata*, Linn.—is more slender in its form; the head and thorax are brassy-green, the latter with two grayish lines down the back; the face is ochreous and hoary; horns bright rust-colour, black above; eyes as usual; scutel ochreous, more or less brassy at the base; body elliptical, shining black, with two bright ochreous spots on each side of the base, and uniting outside: there are also six bands of the same colour, the first and third being narrow; wings as usual; legs and under side of body entirely ochreous; length, 4½ lines; 10 in expanse (fig. 1)

During July, August, and September, these flies are abundant in every garden, field, and hedge, and I have bred them even in October. The maggots are yellowish-white (fig. 2), with broken scarlet lines down the back, and black spots and marks between them, which are caused by the food in the intestines shining through; the head is furnished beneath with two minute hooks or teeth, and there is a tubercle at the rump composed of two lobes, with which the animal adheres to any object; and there are minute bristles on the sides. Out of one of the pupæ (fig. 3) came three or four little parasitic maggots, which lived through the winter; and the first week of April they produced some small flies, very similar to No. 8, p. 74, which I take to be the *Ceraphron Syrphii* of Bouché,* who bred them likewise from the pupæ of *S. Ribesii*. One of the Ichneumonidæ, called by Gravenhorst *Bassus albosignatus*,† also lays its eggs in the larvæ of *S. balteata*.

22. *S. scripta*, Linn.—is much smaller than the foregoing insects, and the males have a much narrower body: the face is yellow; the horns orange; thorax dull green, the sides and scutel yellow; body long and narrow in the males, with two bright ochreous spots towards the base, two bands of the same colour farther down; the penultimate segment has a V-shaped ochreous mark on the centre, with a dot on each side, and the apex is also ochreous, with a few black dots; the legs are entirely ochreous; length, 4¾ lines; expanse, 7 lines.

This and many allied species are abundant everywhere, especially in meadows and ditches, from midsummer to October. I may mention also that the Baron De Geer‡ describes and figures a blood-red acarus or mite which seizes the aphides by the back, belly, or neck, as a ferret would a rat, and sucks out all the juices; and I find that earwigs assist in diminishing the plant lice, by feeding upon them in the curled leaves, where those troublesome insects shelter themselves after their nocturnal excursions.

Severe frosts are exceedingly beneficial in the destruction of noxious

* Bouché's *Naturg. der Insecten*, p. 175, Plate 7. fig. 33 and 36 to 39, and fig. 41.

† Curtis's *Guide*, Gen. 520, 20.

‡ *Mémoires*, vol. vii. p. 122, Plate 7, fig. 13, 14.

insects; and although the aphides can resist cold to a considerable amount, having survived the weather when the thermometer was as low as 29° Fah., not only are immense quantities destroyed by intense cold, but a check is given in another way to their increase, for in mild winters little doubt can be entertained that they not only survive, but are actually propagating; and Mr. W. Curtis very sensibly remarks, that as their enemies, on the contrary, exist, but do not multiply, during such periods, the aphides get the start of them, and thus obtain an ascendency, which once acquired is not easily overcome.* I have been surprised to see how slightly aphides are affected by wet; and I find that the same careful observer of nature tried a few experiments to ascertain how far they could resist the action of water. Mr. W. Curtis first immersed some aphides attached to a willow-twig in water for sixteen hours, which did not appear to incommode them in the least, for on being taken out and placed in the sun, they increased and multiplied shortly afterwards; but when they were brushed off, they could not so long sustain the effect of water. He afterwards immersed two other sorts of aphides, which at the expiration of twelve hours were all dead: this difference of power in the vital principle is very remarkable, and not easily explained. Their capability of resisting some gases or effluvia is likewise very astonishing: for instance, I took some aphides from the southernwood, both winged and apterous, and corked them up in a quill containing a piece of camphor, which produced an atmosphere that killed most insects in an hour, but the aphides were walking about unaffected, after being confined there twenty-four hours!

DROSOPHILA† *and* PHYTOMYZA.‡—*Turnip-leaf Miners.*

Turnip-leaves are often more or less covered with whitish blisters, which are caused by the maggots of two different kinds of flies, both of which belong to the order DIPTERA and the family MUSCIDÆ. It does not appear that they do much mischief to the crops, but it may be questionable whether the maggots do not occasionally generate disease in cattle feeding upon the turnip tops, when their numbers are in excess. The first species, which is called *Drosophila*, belongs to a group, the larvæ of some living in vinegar and acid beer, many breeding in *Boleti;* and others, like the one before us, live upon the parenchyma or pulp of the leaves of various plants: some of the flies are frequently found in cellars, and are also seen running over the windows in our houses.

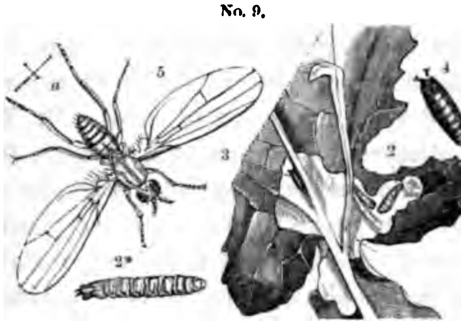
* *Transactions of the Linnean Society*, vol. vi. p. 84.

† Curtis's *British Entomology*, fol. and Plate 473; *Guide*, Gen. 1334.

‡ Curtis's *British Entomology*, fol. and Plate 393; *Guide*, Gen. 1348.

It is not a little singular that, as far as my observations go, the maggots of the turnip *Drosophila* form their dwellings so carefully under the upper cuticle of the leaves that not a trace of them can be seen on the under side, whilst the habits of the larvæ of the *Phytomyzæ* are just the reverse: the economy of the former I will now investigate. On the 22d of July, 1841, I saw many leaves of some English turnips disfigured by large pale blisters on various parts of the upper side (Plate C, fig. 1): upon examination I found that many of them were empty, but in two or three I detected maggots by holding the leaf up to the light (Plate C, fig. 2; and No. 9, fig. 2; and 2*, magnified); they were of a pale green colour, the mouth being armed with two little horny hooks; one changed to a pupa (figs. 3) inside of the blister the same day, and another I found dead shortly after at the bottom of the tin box in which they were placed, and in a day or two I saw another pale greenish maggot in a box with a blistered leaf, which soon buried itself under the cuticle, and changed to a pupa of a chestnut colour, with two divaricating horns on the head (figs. 4), and on the 4th of August I bred from it a fly (figs. 5), which agrees pretty well with Fallen's description of—

No. 9.

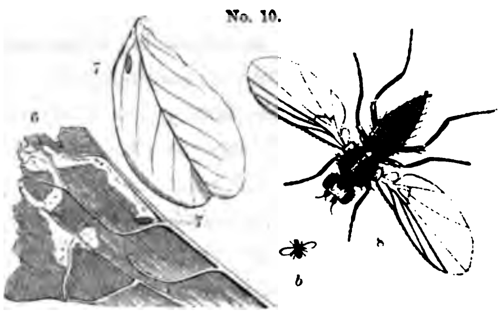


23. *Drosophila flava.*—It is ochreous, sparingly covered with black bristles; the face is silky white; eyes black; and the lobes at the apex of the abdomen are black; the seta or bristle of the horns is likewise black and only feathered above, and there is a slate-coloured spot on the crown where the three little eyes are placed: down the centre of the thorax is a light rusty line, with the indication of one on each side; the legs are very pale ochreous; the wings are yellowish but iridescent, and the nervures are pale brown: length, 1 line; expanse, 2¾.

In October numbers of the leaves amongst the Swedish turnips likewise exhibited pale patches, which were almost white, or the colour of parchment above; but, as usual, no indications of their being infested were visible beneath. In these blisters I found sometimes as many as three maggots, which I presume were the offspring of a second brood: they shortly became brown pupæ at the bottom of the box, from which I am induced to infer that they often come out of the blisters when arrived at maturity, and enter the earth to undergo their transformation to the chrysalis state. From some of the earlier pupæ I obtained two little parasitic hymenopterous flies; one appears to be the *Ceraphron niger** of my cabinet; and the other is, I believe, *Miscogaster cinctipes* of Walker.†

The other fly, called PHYTOMYZA, is bred from the *under sides* of the turnip-leaves, where the maggots form long irregular galleries (Plate C, and No. 10, figs. 6) inside of the lower cuticle, and these miners are not visible on the upper side of the leaf. One of the maggots changed in the third week in July ‡ to a dark-brown pupa (figs. 7) beneath the epidermis, and it was furnished with two small horns at the head, and also at the tail; on the 28th a fly came forth, which was the—

No. 10.

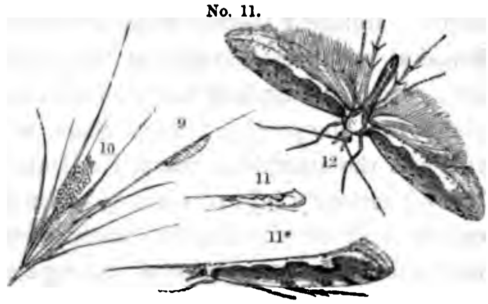


24. *Phytomyza nigricornis* of Macquart (figs. 8).—It was slate-black, the head and thorax were sprinkled with a few black bristles; the horns are brown, with a naked bristle; the head is pale ochreous, excepting a spot on the crown; the tips of the thighs and the poisers are yellowish-white; the wings are pale slate-colour, with three strong and three faint nervures; length, 1 line; expanse, 2½.

CEROSTOMA XYLOSTELLA.—*The Turnip Diamond-back Moth.*§

We now arrive at the history of a small moth, which is very abundant in turnip fields; and, according to one of my correspondents, occasionally does considerable mischief. The caterpillar (Plate C; and No. 11, figs. 9) is spindle-shaped, of a delicate green, sometimes inclining to yellow, with a gray head; it has six pectoral, eight abdominal, and two anal feet; all of which are green. On the Continent it lives principally upon the upright honeysuckle, *Lonicera xylosteum*, and attacks a great number of culinary

No. 11.



* Curtis's *Guide*, Gen. 581 *b*, 41. † Ibid. Gen. 638, 28.

‡ Mr. Hardy found the larvæ as early as the 18th July, mining the turnip-leaves, and the flies hatched the 3d September, having been in pupæ about twenty-one days. The larvæ are also found in the leaves of the pea and various wild plants.—See *Proceedings of Berwickshire Club*, pp. 339–362.

§ Curtis's *British Entomology*, fol. and Plate 420; *Guide*, Gen. 1031, 4.

plants; but seems to prefer the cabbage and the turnip. Godart says that it lives in a slight web generally attached to the under surface of the leaves; and when it is about to become a chrysalis, it spins within the web a cocoon-like network, in which it changes to a yellow testaceous pupa (figs. 10); the moth comes forth in about eighteen days: Linnæus gave it the name of *Tinea xylostella*, from its feeding upon a honeysuckle which bears that name. It still belongs to the family TINEIDÆ, but by modern naturalists it has been separated from that immense group of LEPIDOPTERA, and is now described by Latreille and others as—

25. *Cerostoma xylostella.*—When at rest the wings are closed and deflexed, and the horns are projected forward in a straight line (figs. 11; and 11*, magnified). It is more or less brown, the slender horns are white, a tuft of scales on the crown of the head, and the disk of the thorax are whitish ochre; the superior wings, which are long and narrow, have three or four pale spots upon the anterior margin towards the apex, and all along the inner margin is an indented white or ochreous stripe, which forms, when the wings are closed, two or three diamonds upon the back; the fringe is purplish, variegated with black scales; the inferior wings are lance-shaped, and of an ash-colour, with a very long fringe; the body is slender, and of the same colour, the apex ochreous: length, 2¼ lines; expanse, 7 lines; (figs. 12, magnified).

This species, says M. Duponchel,* is spread over all Europe, and has two generations in a year; the one appears in June, and the other at the end of summer. In this country there seems to be a succession of broods from midsummer until the approach of winter, for I have taken specimens in the gardens near London in the end of June, at Dover in July, Scotland in August, and frequently amongst turnips in September and October in Suffolk and Essex. Monsieur Desjardins says† that it exists also in the Mauritius, where it makes very great ravages in the kitchen gardens; but whether it is indigenous to that island, or has been transported from Europe with the cabbage-plants that the people cultivate there, is unknown. I have little doubt that this was the caterpillar which Mr. Dalgavings, of Forfarshire, mentioned as having seriously injured his crop of turnips in 1826. I am, however, particularly desirous of calling the attention of agriculturists to this enemy of the turnip crop, in consequence of having received the following communication from Mr. J. Weaver, who lives in the neighbourhood of Petersfield, Hants:—"The little moth which I have sent is one from a host of small green caterpillars which have been exciting some surprise here this summer. About the beginning of August I was directed to a field of turnips said to be infested

* Godart's *Lepidoptères de France*, vol. viii. p. 214.

† *Annales de la Soc. Ent. de France*, vol. vi. p. 229.

by the 'niggers;' they proved, however, to be myriads of tiny larvæ, averaging perhaps half an inch in length each, slender, and somewhat tapering at both ends, and of a green colour when full fed. They were exceedingly active, and on the slightest touch would wriggle themselves off from the leaf on which they were feeding, let themselves down by a silken thread, and remain suspended till the cause of alarm had subsided, when they would regain their former position. So incredible were their numbers, that on a single plant of moderate size, and taken at random, I counted upwards of 240!—and before the end of the first week in August every leaf, for the space of more than an acre, was completely reduced to a parched-up skeleton: not a turnip escaped them, and by the middle of the month you might have looked in vain for the smallest vestige of a green leaf on the field of their depredations; and to this day (October 29, 1837) it is as bare as if nothing had been sown there. Similar patches, from a like cause, may be seen in two or three other fields in this neighbourhood, where a most excellent crop is yielded in every other part. On the 9th they began spinning their cocoons, which are of the most beautiful net-like texture, some on the dried fibres of the turnip-leaves and others upon the ground. The perfect insects emerged about the 20th; but out of seventeen cocoons five moths only hatched, while the remaining twelve produced the accompanying parasite." This was one of the ICHNEUMONIDÆ, and is called by Gravenhorst—

26. *Campoplex paniscus.**—It is black; the antennæ are slender and shorter than the body; lower part of face silvery; mouth straw-colour; body attached by a narrow neck; the apex of the female armed with a slender shortish tripartite ovipositor, like a tail: wings very transparent and iridescent; the nervures and stigma yellowish-brown; superior with nine cells and a minute areolet; thighs bright rust-colour; shanks paler, hinder often whitish, with the apex and a ring near the base pitchy; feet brown at the apex, hinder fuscous, excepting the base, which is white: length, 2¼ lines; ovipositor, 1 line; expanse from 4½ to 5 lines.

This insect is abundant in July and August, upon almost every umbelliferous plant in fields and hedges, feeding in the flowers, and searching for caterpillars for the purpose of depositing eggs in them.

PLUSIA GAMMA.—*The Y-moth.*†

Although I am not aware of any instance being recorded where serious mischief has been occasioned by the caterpillars of the Y-moth in this

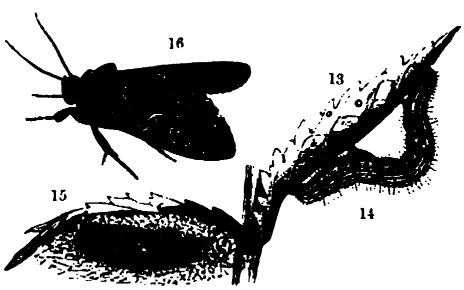
* Curtis's *Guide*, Gen. 529, 29.

† Curtis's *British Entomology*, fol. and Plate 731.

country, it has caused such ravages abroad that it is well deserving of our attention, especially when we consider the multitudes of this species of moth that often appear in our fields and gardens.

The eggs laid by the female Y-moth are very beautiful, resembling an *echinus* in shape, as well as in their curiously sculptured surface (Plate C, fig. 13, magnified; and No. 12, fig. 13, natural size): they are generally attached to the under side of a leaf in considerable clusters,* and I believe that the young caterpillars are very unlike the full-fed ones. After changing their skins several times they become of a green colour, and are covered with very short hairs; the head is greenish-brown; there are six white or bluish lines down the back, and a yellow streak along each side; the spiracles or breathing pores are black; they have six pectoral or horny feet, only four abdominal, and two anal, which are all green and fleshy (figs. 14): these larvæ, which form an imperfect loop in walking, I have frequently found feeding upon turnip leaves, but they will live upon a variety of vegetables, upon stinging and dead nettles, and even on grasses, if pressed by hunger. When they have arrived at their full growth, they spin a woolly white cocoon, either between the folds of a leaf or against the stalk of a plant, within which they change to a pitch-coloured chrysalis (figs. 15), distinguished by a considerable protuberance at the base of the abdomen, owing to the long proboscis being bent back at that point. The beautiful moth produced from these chrysalides belongs to the order LEPIDOPTERA, of the family NOCTUIDÆ, and is now characterized as the—

No. 12.



27. *Plusia* (*Noctua*) *gamma*, Linn.—The tongue is very long and spiral; the horns are like fine bristles; the head and thorax are of a purplish brown, the latter is crested; the wings when at rest are closed and a little deflexed; the superior are somewhat lance-shaped, shining like satin, of a dull blossom colour with a slight coppery tinge, and beautifully variegated with brown and gray, and at the centre is a pale golden letter like the Greek γ; the body and inferior wings are smoky; the former has a few tufts of scales on the back near the base, and the latter are often of a whitish blossom colour across the centre, leaving a broad brown margin; the fringe is whitish, with

* Sepp represents them laid singly.

a line of blackish spots: it is ¾ inch long, and more than 1½ inch in expanse (No. 12, fig. 16, the moth at rest; and Plate C, fig. 16, the same flying).

From the green colour of the caterpillars they are difficult to detect: yet they must be very abundant, from the immense quantities of the moths we see flying about fields, hedges, heaths, and gardens, from the early spring until the end of autumn, but they are most abundant in July and October. It has been remarked in France that rainy seasons seem to be more favourable to their increase than dry years; and in October, 1816, they rose in swarms in the northern departments, as persons walked over the fields.* In 1735 the caterpillars did incredible mischief to the market gardens around Paris, eating up the pease and beans, so that only the stalks and fragments of the leaves were left, and refusing nothing but the lentils: their ravages extended to Tours, and in Auvergne and Burgundy they destroyed the crops of hemp; and not only did the gardens suffer, but whole fields of culinary plants were consumed, and so great were their numbers that at any one time several scores and more could be seen in the highways going from one field to another in search of food,† where they would not refuse either clover or grasses, but they did not touch either wheat, rye, or barley, although later in the season they attacked the oats.

These extraordinary swarms of insects, and their irregular returns, may be sometimes owing to the mildness of the foregoing winter: in the instance just related, there had been no severe frosts either in the winter or spring, so that the previous autumnal broods of caterpillars lived through the cold season, and it necessarily followed that an immense number of the moths were produced, and the spring and summer which succeeded proving favourable to their increase, they became more abundant than they had ever been known before. It is only surprising that such events do not oftener occur, when we consider the rapidity with which insects increase. Let us, for instance, suppose that no accident interfered with the progress of the different broods of this moth, of which there are two every year: it is believed that one female moth will lay about 400 eggs, which would be transformed in a few weeks to 400 moths: if we allow half of these to be females, they would lay at the same rate 80,000 eggs, which would in the following autumn (admitting that the first was a vernal moth) become perfect insects, whose eggs, taking again half of them as females, would amount to the prodigious number of 16,000,000, which would hatch the following spring, and be ready to devastate the spot on which they were bred: there must be, consequently, innumerable agents in operation to stop their increase,

* Godart's *Lepidop. de France*, vol. vii. part ii. p. 43.

† Reaumur, *Hist. des Ins.*, vol. ii. p. 326.

although I do not happen to have met with the species of ichneumons, &c., which are destined to preserve our green crops from being annihilated by the caterpillars of the Y-moth.

Plusia gamma is a widely-dispersed insect, being found all over Europe, and it is said to extend even to the frontiers of China and Siberia: it likewise inhabits North America. Unlike most other species of *Noctuidæ*, this moth flies about by day, not only in the sunshine, but regardless of the weather; it will be seen on dull and even damp days hovering over flowers, and, like a sphinx-moth, thrusting in its long spiral proboscis or tongue to extract honey from the nectaries; at other times, fluttering and running over the flowers, or resting upon them with its wings closed. There is no moth more shy and difficult to catch by day, for it will seldom allow any one to come near it; but whether it detects the approach of man by its eyes, which sparkle like living rubies, or by its hearing, is not known: it darts off, however, in an instant when disturbed, and stops again a few yards off, or entirely vanishes.

Should the Y-moth caterpillars ever become fearfully abundant in our turnip fields, it is not improbable that ducks, poultry, and sheep might be very serviceable in diminishing their numbers, if employed as recommended in the last chapter upon the black caterpillar.

Having now given an account of several kinds of insects connected with the turnip crops, I shall leave for a future chapter the history of some others which are equally interesting, and not less destructive. The following summary will be useful, by placing before the reader, in a concise form, the results of my investigations:—

HISTORY OF THE APHIDES, OR PLANT-LICE.

Every crop, both in the fields and gardens, is subject to the attacks of various species.

Three different sorts infest the *leaves* of the English turnips; one haunts the leaves of the Swedes, and another the *flower-stalks*.

The *green tops* are rendered less fit for cattle when infested with aphides, and the growth of the *plants* and the *roots* is retarded.

One hundred and sixty-eight aphides were seen upon one small turnip-leaf in July.

It is by thrusting their *beaks*, called the rostrum, into the plants, and imbibing the sap, that they injure our crops.

The females are both *oviparous* and *viviparous:* they are *winged* and *apterous*.

In autumn they lay *eggs*, which hatch the following spring.

The *eggs* are laid upon the leaves, under the buds, and other secure places.

The females *bring forth young*, without sexual intercourse, for many generations.

Their *increase* is prodigious: it is calculated that one female might be the progenitor of upwards of 5900 millions of descendants in one year.

The *eggs hatch* about the period of north and north-east winds, in March and April.

Their increase is accelerated by *damp sultry* weather as the season advances.

Electricity probably often causes their simultaneous appearance.

The *aphides* can *walk* about as soon as they are born, and are able to do so until their lives are terminated.

Abundant in August, September, and October, and even at the end of November, secreted beneath the diseased leaves.

It is doubtful if these species deposit the saccharine matter called *honey-dew.*

Cutting off the infested leaves and destroying them on the spot, or carrying them away in sacks to be burned, is the best remedy.

Tobacco and *lime-water* will kill the aphides. Lime-dust, if strewed in dry weather, is an effective cure.

They often do not suffer from *heavy rains.*

Insectivorous birds, and various *insects*, our best friends in checking their increase.

The *lady-birds* and their *larvæ* are particularly useful in destroying the aphides.

Immense *swarms* of the *lady-birds* sometimes appear on our shores.

A little fly called *Aphidius* lays its *eggs* in the *aphides*, and when they hatch the maggot destroys the aphis.

These again become the *victims* of other small flies, called *Ceraphron Carpenteri*, *Asaphes vulgaris*, and *Coruna clavata.*

Some of the *Cynipsidæ*, or *gall-flies*, are also parasites, which live in the aphides as maggots.

Four other *wasp-like flies* collect the aphides as food for their young.

The *aphis-lion*, or larva of the *golden-eye fly*, destroys the aphides; and the *maggots* of some two-winged flies called *Syrphi* are still more serviceable in their destruction.

These are, however, in their turn infested with a *parasite* called *Ceraphron syrphi.*

Severe frosts destroy the aphides, but they are able to propagate in mild winters.

When *immersed in water* for sixteen hours, it has not killed them.

An atmosphere strongly impregnated with *camphor* did not affect them in twenty-four hours.

The TURNIP-LEAF MINERS may generate diseases in cattle, when they greatly abound.

One called *Drosophila flava* causes large blisters on the upper sides of the leaves, which contain the maggots.

The other, named *Phytomyza nigricornis,* is the parent of a maggot which eats galleries in the under sides of the leaves.

The TURNIP DIAMOND-BACK MOTH: the larvæ feed upon the turnip-leaves, and sometimes nothing but the fibres are left.

The *chrysalis* is inclosed in a net-work cocoon, attached to the dried fibres, or formed upon the ground.

It is found all over *Europe* from midsummer to November, and does great mischief in the kitchen gardens in the Mauritius.

Upwards of 240 of the caterpillars have been found upon one plant.

A *parasitic ichneumon* lays its eggs in the caterpillars.

The Y-MOTH lays its eggs on the under side of turnip-leaves and other plants.

The green *caterpillar* feeds upon the turnip-leaves and a variety of plants.

The *chrysalis* is inclosed in a white web, often spun in the folds of the leaves.

The *moths* are abundant from April till October, especially in the latter month, and in July.

Rainy seasons seem to be congenial to their increase.

In October, 1816, the *moths* swarmed in the north of France.

In 1735, the *caterpillars* ate up all the vegetables around *Paris*, excepting lentils.

Their ravages extended to the centre and south of France, where they consumed the *hemp crops*, and did not refuse *grasses* and *clover*.

They spared the *corn crops*, but attacked the *oats* later in the season.

The previous *winter* and *spring* had been very mild.

One female Y-moth in the spring might become the progenitor of 16,000,000 caterpillars, in the space of twelve months, viz.:—from the spring of one year to the following spring.

PLATE C.

TURNIP CROPS.

Two winged flies and Moths whose Caterpillars feed on Turnip leaves.

It is dispersed over all *Europe*, to the confines of Siberia and China, and is also an inhabitant of North America.

It *flies* by day as well as at night.

Ducks, poultry, and sheep recommended to destroy the caterpillars.

EXPLANATION OF PLATE C.

Fig. 1. A turnip-leaf, upper side.
Fig. 2. The maggot of *Drosophila flava*, feeding under the cuticle.
Fig. 3. The pupa of ditto.
Fig. 4.* The same greatly magnified.
Fig. 5.* *Drosophila flava* represented flying.
a, The natural dimensions.
Fig. 6. The gallery formed on the under side of a turnip-leaf by the maggot of *Phytomyza nigricornis.*
Fig. 7. The pupa of ditto secured under the cuticle.
Fig. 8.* *Phytomyza nigricornis* represented flying.
b, The natural dimensions.
Fig. 9. The caterpillar of the turnip diamond-back moth.
Fig. 10. The pupa of the same inclosed in the cocoon.
Fig. 11. The moth from the same represented at rest.
Fig. 12.* The same flying and magnified.
Fig. 13.* The egg of the Y-moth.
c, The natural size.
Fig. 14. The full-grown caterpillar walking.
Fig. 15. The chrysalis in its web.
Fig. 16. The Y-moth flying.

All the figures are drawn from nature, excepting fig. 9; and the numbers with a * attached, indicate that the objects referred to are represented much larger than life.

CHAPTER IV.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE TURNIP CROPS; INCLUDING THE WHITE CABBAGE-BUTTERFLIES, THE TURNIP-SEED WEEVIL, ETC.

CABBAGE AND TURNIP BUTTERFLIES.

ALTHOUGH some caterpillars will feed upon a great variety of plants, for the most part they are confined to a few, and those are generally of the same natural order; that is to say, they are kindred species. This is the case with the cabbage-butterflies,* whose caterpillars not only frequently completely destroy that useful vegetable in the cottager's garden, but they live to a great, and often to a mischievous extent upon turnips, rape, &c., as will be shown in the sequel. There are three species of these butterflies, belonging to the order LEPIDOPTERA, and to a family called PAPILIONIDÆ, which embraces all butterflies, amounting in Britain to about eighty species,† forming the Linnæan genus Papilio; but the white cabbage-butterflies, and two or three others, have been separated by modern naturalists, and are now distinguished as the genus PONTIA.‡ The largest of these is abundant in gardens, turnip fields, and road-sides, where it is seen on the wing from the middle of May to October: common as it is, and familiar as every child is with the white cabbage-butterfly, how few persons comparatively are acquainted with its origin and transformations! its history will, therefore, prove interesting and instructive; but before we proceed to its economy, it will be necessary to describe it, in order to distinguish it from the two others alluded to. From the mischief the caterpillars occasion to the cabbages, it is called—

1. *P. brassicæ*, Linn., or the White Cabbage-butterfly.—The *male* is white above, the head and thorax are clothed with soft yellowish hairs; the two horns are spotted with black, and the club is black above and

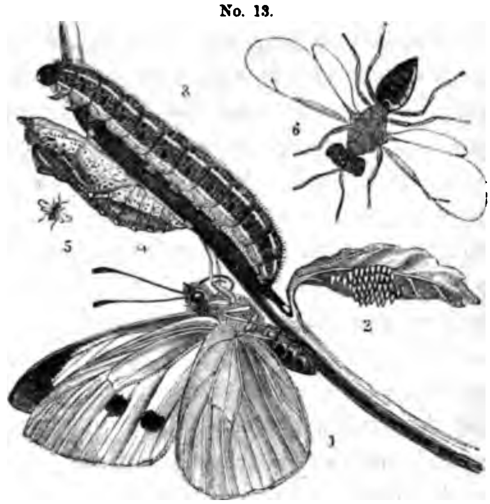
* *P. rapæ* departs from this rule, for it has been found feeding upon the weeping-willow and some flowers which are not cruciferous.

† Curtis's *Guide*, Gen. 763–780.

‡ Curtis's *British Entomology*, fol. and Plate 48.

ochreous beneath; the upper wings have black tips in the form of a crescent; the inferior wings have a blackish spot on the upper edge; the body is black; the wings expand 2½ inches: the *female* (No. 13, fig. 1) is larger, being about 3 inches across, and is distinguished by two large black spots on the upper wings, and a freckled splash upon the inferior margin; the under sides are alike in both sexes, the upper wings being white, with the tips yellow, and two large black spots near the centre; the under wings are likewise palish yellow, freckled with black; the head is furnished with two hairy feelers in front, called palpi, the tips being pointed, and between them is concealed a long spiral tongue or proboscis.

No. 13.



The female deposits her eggs on various cruciferous plants, especially cabbages, turnips, mustard, rape, radishes, horse-radish, and water-cresses: they are laid on the under side of the leaves, in clusters of twenty or thirty (fig. 2), and are somewhat of the shape of a sugar-loaf, bright yellow, curiously furrowed and reticulated. There is a constant succession of broods during the summer and autumn; one which attracted my notice hatched the 27th of August, and the little caterpillars immediately consumed all the egg-shells: on the following day they were of a green colour before, and yellow behind; a little hairy, with the head, two spots on the first thoracic segment, another on the tail, and numerous little dots, black: they kept together, feeding upon the turnip-leaf in groups, and in one night a single family ate a large hole completely through; they had six pectoral, eight abdominal, and two anal feet, and possessed the power of spinning a fine slight web over the surface, probably to enable them to hold more securely to their food: in six days they changed their skins, after which they dispersed over the leaves; in about the same space of time they cast their skins a second time, when they were at least ½ inch long, leaving their exuviæ sticking to the stalks. When full grown they attain to the length of about 1½ inch, and are as thick as a small goose-quill; they are then pale blue or green above, yellow beneath, with a line of the same colour down the back, edged with black dots; there is likewise a row of large black spots down each side, and numerous minute dots, as well as fine hairs, scattered over the body (fig. 3). Having arrived at this stage, they generally wander to some secure place, under ledges of paling, coping of walls, branches of trees, hedges, &c., and there attach their tails to some object, by very tough silken threads, and afterwards spin a similar cord from their mouths, which is fastened round the animal to support its head in an elevated position, and, gradually contracting its body, the skin is slipped off, and it is instantly changed to a shining pale green chrysalis, spotted and dotted with black (fig. 4); and in this tranquil state the latter broods rest suspended, uninjured by the storms and frosts of winter, until the genial warmth of spring calls the sleeping inmate into active life; and, as this proceeds, the black spots of the wings, although in miniature, gradually become more distinct through the horny transparent shell, and eventually the butterfly bursts the back of the chrysalis, crawls out, and, holding by some object so that the little wings hang down, the fluids descend into them, they rapidly expand, and in the course of half an hour have attained their full size; they are, however, still flaccid, and require some time to dry and become adapted to flight.

The caterpillars of the white cabbage-butterfly greatly injured some Swedish turnips in the end of September, 1841, and no doubt frequently assist in reducing the foliage very considerably; but it is when the turnips, &c., are in seed that they are most to be feared. In July of the same year I received some of the caterpillars from Mr. C. Parsons, of Southchurch, Essex, who informed me that they were then committing extensive ravages on the white-mustard crops in parts of that neighbourhood, by eating off all the pods, and leaving the stalks bare. They commenced at the point of the pod, and continued eating until it was demolished, even to the base of the foot-stalk. "Had they attacked the crop," says Mr. Parsons, "at an earlier period of the season, the consequences would have been very serious indeed. Mustard-seed, both white and brown (*Sinapis alba* and *nigra*), is subject to the attacks of a small black larva, which I have not seen this year; but the damage done by the caterpillars I have sent has never been noticed in this neighbourhood."

I placed some of these larvæ upon radishes and turnips in seed, the green pods of which they were equally fond of, and ate, as above stated. They grew most rapidly during the few hot dry days we had near the middle of September, 1841, resting lengthways upon the naked stalks, after having cleared off all the seed-vessels: on the 20th they appeared healthy, but inclining rather to a yellow colour; it rained during the night, and, on looking at them in the afternoon of the following day, I saw they had removed to a leaf, to which they stuck by four of their hinder legs, and, to my surprise, they were of a dirty colour, and rotten, the skins being lax, and lying just as the wind blew them about. I found they only contained some cream-coloured fluid, a portion of which was scattered upon the leaves. From this fact it may be inferred that wet is sometimes very destructive to these caterpillars,* probably during hot weather only; for after the heavy rains which fell in the end of September and in October, I was astonished to see the cabbages in the cottage gardens in Suffolk with multitudes of these caterpillars half and full grown, which had injured the crops so extensively, that not a leaf had escaped. It is scarcely credible that the labouring classes should thus suffer their crops to be spoiled, and their labour to be lost, when a little hand picking every evening would soon relieve their gardens from these unwelcome visitors; but so it is.

If it were not for numerous parasitical insects, which deposit their eggs in those of the Pontia, and especially in the caterpillars and pupæ, all chance of keeping them under in the field would be fruitless: the most serviceable of these agents is a little fly, which must be produced in myriads, for I have sometimes found that every caterpillar had been stung by this insect, which belongs to the order HYMENOPTERA, of the family ICHNEUMONIDES ADSCITI, and is named

2. *Microgaster glomeratus*, Linn.†—It is black and thickly punctured; the horns are thread-like, longer than the body in the male, shorter in the female, and composed of eighteen joints or upwards; the eyes are lateral, with three little eyes or ocelli upon the crown; the abdomen is shorter than the thorax, depressed, linear, smooth and shining; the basal segment is a little narrowed, with the edges on the sides dirty white; ovipositor concealed beneath the abdomen; the four wings are very transparent, iridescent, with a distinct pitchy-coloured stigma on the superior; the nervures lighter, the areolet open externally; legs bright ochreous, hinder thighs black on the upper edge, darkest at the apex, tips of their shanks and tarsi brownish, the apex only of the four anterior brown: length, a little more than one line; expanse, 2¾ lines.

This minute ichneumon-fly lays numerous eggs in the caterpillars of the white cabbage-butterfly, which hatch and feed within their skins in almost incredible numbers, the victim feeding and growing until it has attained its full size; when, instead of changing into a chrysalis, like fig. 4, a number of fleshy maggots come through its skin, and form beautiful little oval silken

* Most caterpillars are purged by wet, as we have stated in a former chapter, but these do not appear to suffer invariably.—J. C.

† Curtis's *British Entomology*, fol. and Plate 321; and *Guide*, Gen. 554, No. 54.

cocoons in masses beneath and around it, like the balls of the silkworm in miniature; they are bright yellow, and I counted sixty-seven which issued from one unfortunate larva. On opening a caterpillar thus infested, it will be found full of little fat maggots, which eventually consume all the muscles and fat, leaving only the alimentary canal untouched; those in my possession, which spun up in September, hatched the beginning of the following May, when they were ready to commence their invaluable operations upon the early broods of the white cabbage-butterflies. Reaumur says the *Microgaster* pierces the skin of the caterpillar with its short oviduct, and deposits an egg; it then withdraws it, and repeats the operation, until thirty eggs or more are introduced into the living caterpillar, and they are inserted sufficiently deep not to be cast off with the skin: the maggots avoid feeding on the vital parts, so that the caterpillar does not die until two or three days after the parasites have eaten their way out to spin their cocoons,* but the caterpillar, being exhausted, generally dies close to his murderers. Even these parasites are subject to the attacks of a beautiful little fly, called *Diplolepis (Pteromalus?) Microgastri* of Bouché,† the maggots of which live in the pupæ of *Microgaster glomeratus*, three or four together, and the silken cases which are inhabited by these parasites are paler than the healthy ones: thus one little animal lives upon another; so that the laughable lines of the facetious poet are partly verified:—

> "That fleas have little fleas to bite 'em,
> And so go on *ad infinitum*."

Persons who are ignorant of the wonderful operations of nature, often mistake these yellow cocoons formed by the maggots for the eggs of the caterpillars, and accordingly destroy them, although they ought rather to be preserved; and others, on opening a caterpillar of the white cabbage-butterfly, and finding it full of little maggots, have supposed they were the young of it. Such errors are the offspring of ignorance, and contrary to the laws which regulate the generation of these animals; and I trust that these careful investigations will meet with the attention of agriculturists, that they may take a correct view of these subjects, which are at once interesting and of absolute importance to mankind.

There is also a large ichneumon-fly, the larva of which lives singly in the chrysalis of *P. brassicæ*, and changes into a white pupa inside, without

* I have since seen a maggot protruded through the apex of one of the abdominal feet; it was of a dirty green colour.

† *Naturgeschichte der Insecten*, p. 168.

forming any case: the fly hatches in two or three weeks; it is likewise hymenopterous, and of the family ICHNEUMONIDÆ: it has been named

3. *Pimpla instigator*, Fab.*—It is black and thickly punctured; the two slender horns are not so long as the body, and composed of numerous oblong joints: the elliptical abdomen is only slightly narrowed at the base; the thighs, shanks, and feet are bright fulvous, excepting the hinder feet, which are brown or black; the four wings are dull-yellowish, but iridescent; the stigma and nervures brown, the areolet is rhomboidal; the female has a stout ovipositor projecting beyond the apex, and is nearly half as long as the abdomen: the male is often half an inch long, the wings expanding more than three quarters of an inch, and the female is considerably larger. This powerful insect likewise infests the caterpillars of many moths, and emits a most offensive scent when touched: I have frequently seen the females running over fruit-trees, investigating every leaf and crevice to find a proper object to receive their eggs: they are met with from midsummer to Michaelmas.

There are other parasites which destroy the chrysalides; and one of the most essential of these is a minute brilliant fly, which deposits its eggs upon the outside of the chrysalis of the butterfly as soon as the caterpillar has cast off its skin, when it is both soft, tender, and exhausted, so that it has not the power to exert itself and frighten away the little parasites; the eggs soon hatch and eat into the pupa, which at that early stage is almost liquid inside, the members of the future butterfly not being organized. Sometimes 200 or 300 of these little maggots live in one chrysalis; they undergo their metamorphoses securely within the shell, and the flies hatch and eat their way out in about fourteen days in summer, but some remain through the winter, and when they come forth they do not fly away, but hover in swarms about the perforated pupa, the males probably hatching first and waiting until the females emerge to be impregnated; but after their bridal dance, each female departs in search of recently formed chrysalides to deposit fresh broods in. If we take 250 as the average number of eggs which a female lays, and admit that one-half of them are of that sex, the second generation would amount to upwards of 30,000, an enormous increase, which is in all probability multiplied several times in the course of one season. Some species of this extensive genus swarm even in our houses, especially in the country, where in October and November I have seen immense numbers inside of the windows, and I believe they hybernate behind the shutters, in the curtains, &c. The species above alluded to is likewise

* Curtis's *British Entomology*, fol. and Plate 214; and *Guide*, Gen. 515, No. 103.

hymenopterous, and of the family CYNIPIDÆ or CHALCIDIDÆ; it may be the *Ichneumon puparum* of Linnæus, but as that is very doubtful, I have named it

4. *Pteromalus brassicæ.** — *Female* dull blackish-green, thickly punctured; head large, antennæ clavate, black, basal joint ochreous; abdomen oval, depressed and pointed, black, shining, bright green at the base, with a violet tint beyond it; wings transparent, iridescent, with an ochreous nervure along the upper or costal margin of the superior, forming a short branch beyond the middle; legs bright ochre, coxæ black, thighs, excepting the base and tips, pitchy; middle of four hinder shanks brown; apex of feet black; length, 1 line; expanse, nearly 3 lines (fig. 5; 6, magnified).

The first broods of this little parasite hatch in April, and I have bred multitudes of them from a chrysalis of *Pontia brassicæ.* I suspect the following insect will prove to be the male of it, different as it is in appearance, having bred several from the pupa of one of the white cabbage-butterflies many years since, when I gave it the name of

5. *Pteromalus Pontiæ.*†—*Male* brilliant green, thickly punctured, head broad, horns tawny, ochreous at the base, filiform; abdomen linear, concave, apex ovate, very shining, often with a golden tinge; four wings, as in *P. brassicæ;* legs, excepting the coxæ, bright ochreous, tips of feet pitchy; length, rather more than 1 line; expanse, 2½ lines.‡

5[a]. *Polynema gracilis,* Nees.—is a pigmy fly, only 1½ line in expanse, which lays its tiny eggs in those of the white cabbage-butterfly (*Pontia brassicæ*), and, consequently, checks the multiplication of that troublesome visitor to the kitchen garden. It is shining black; the horns are long, slender, flail-shaped, clubbed, and ochreous at the base; abdomen conical and acute, with a short projecting ovipositor; the base narrowed, with an ochreous petiole; wings transparent, pubescent, without nervures; legs slender and ochreous, with long feet.

We now come to the second species of white butterfly injurious to turnips; it likewise feeds upon cabbages, mignonette, nasturtiums, &c.; it makes its appearance with the white cabbage-butterfly, which it very much resembles, but is smaller; the eggs vary, and the caterpillar and pupa are quite different: from its feeding on the turnip it is called in England the "Small White" or "Turnip Butterfly," and for the same reason Linnæus named it

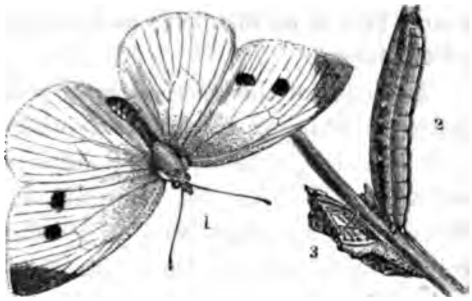
* Curtis's *Guide,* Gen. 627 and 641; and see *British Entomology,* fol. and Plate 166, *Colax dispar.*

† I have since ascertained that these are the sexes of *Pteromalus puparum,* Linn.—*Guide,* Gen. 627, No. 100.

‡ See Morton's *Cyclopedia of Agriculture,* vol. ii. p. 660.

6. *Pontia rapæ.*—The *male* is white, the superior wings have black tips dusted with white, and the inferior wings have a black spot on the upper edge: the *female* (No. 14, fig. 1) is similar, but has two large black spots likewise beyond the centre of the superior wings; under side of the same white, the apex yellow, and two black spots beyond the middle, the lower one sometimes nearly obliterated; inferior wings yellow, freckled with black: length of male, 8 lines; expanse, about 2 inches; the female is larger, and sometimes of a duller colour; but I possess a male, taken near Oldham, in Lancashire, which has all the wings of a bright yellow colour.

No. 14.

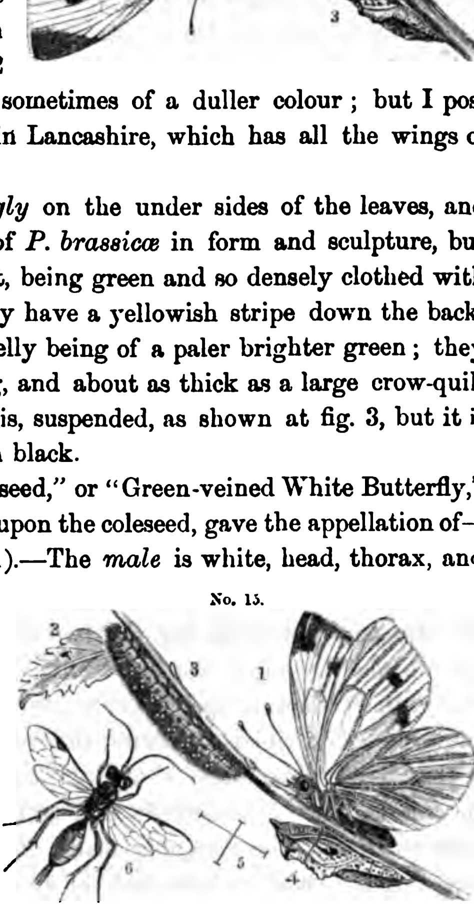


The female lays her eggs *singly* on the under sides of the leaves, and they are not very unlike those of *P. brassicæ* in form and sculpture, but the caterpillars are totally different, being green and so densely clothed with minute hairs as to be velvety; they have a yellowish stripe down the back, and another along each side, the belly being of a paler brighter green; they are often more than an inch long, and about as thick as a large crow-quill (fig. 2); they change to a chrysalis, suspended, as shown at fig. 3, but it is of a pale flesh-brown, freckled with black.

The third species is the "Rape-seed," or "Green-veined White Butterfly," to which Linnæus, from its feeding upon the coleseed, gave the appellation of—

7. *Pontia napi* (Plate D, fig. 1).—The *male* is white, head, thorax, and body black, clothed with yellowish down; superior wings with the tips powdery black and the nervures grayish; inferior wings with a black spot on the upper margin, and the dark nervures shining through. *Female* (No. 15, fig. 1) with the nervures in the superior wings darker, the apex blacker, and two large black spots beyond the middle; under side of superior wings with the same two black spots; the apex is yellow and the nervures are dark, forming gray stripes; the inferior wings are pale-yellow, with the nervures still more distinct, from the broad gray margin which surrounds them. In some examples the ner-

No. 15.



vures are much less strongly marked, which may be a difference between the spring and autumnal broods, or it may arise from their crossing with *P. rapæ*, for hybrids undoubtedly exist amongst insects. The males are nearly ¾ths of an inch long, and scarcely expand 2 inches; the females are a little larger.

The eggs of this species are also laid singly on the under side of the leaves of cabbages, turnips, and other cruciferæ (No. 15, fig. 2); they are long, cylindric, of the form of a sugar-loaf, channelled, striated transversely, and whitish (Plate D, fig. 2, magnified): the caterpillars are about the size of the foregoing; they are of a delicate green colour, densely clothed with velvety hairs, the spiracles or breathing pores down the sides being reddish-yellow (figs. 3); and when lying stretched out on the leaves, as they do by day, they are scarcely visible to the eye. The chrysalis is suspended like the others; it is of a pale greenish-white, or yellow and freckled, with the beak and points brown (figs. 4).

There are two broods of this butterfly in a year, one in April or May, and another in July or August; the caterpillars are most injurious in gardens, where in 1841 they not only fed upon the turnip-leaves, but did great mischief to the cabbages, especially in September, eating the central leaves, like the caterpillar of the cabbage-moth, *Noctua brassicæ*, and I killed several as late as the 22d of September: I have found the pupæ of this species with a largish hole on one side, from which had issued a parasitic ichneumon; and I bred an incredible number, considering their size, of males and females of this fly in July or August from one pupa; it is called by Gravenhorst*—

8. *Hemiteles melanarius.*†—The *male* is entirely black and punctured; the abdomen is roughly punctured, the margins of the segments and the apex are smooth and shining, the two slender horns are scarcely so long as the animal: the wings are beautifully iridescent, the nervures and stigma pitchy, the areolet is open outside; legs black; the apex of four anterior thighs and their tibiæ are tawny, the feet are brownish, but the basal half of the hinder tibiæ alone is tawny: length, 2 lines; expanse, near 4 lines: the *female* differs so materially that no one would suppose it was the legitimate partner of the foregoing male; it is black, but the abdomen is red, excepting the basal segment and the apex; the ovipositor is exserted, and is half the length of the abdomen; the thighs and shanks are red, the apex of the hinder tibiæ and all the tarsi are brown: length, including the ovipositor, nearly 3½ lines; expanse, almost 5 lines (No. 15, fig. 5; 6, magnified).

* *Ichneumonologia Europœa*, vol. ii. p. 790, No. 233.

† Curtis's *Guide*, Gen. 503, No. 233.

Where any of the white butterfly caterpillars abound, there are several methods of reducing their numbers and checking their increase; the best is to look in the winter for the chrysalides, which are concealed under ledges of walls, paling, doors, window-sills, on bushes in hedges, on the trunks of trees, &c., and crush them, but on no account to destroy the dark-brown coloured ones, which are full of the parasitic *Pteromali;* as the spring advances, examine the leaves and bruise the clusters of eggs of the largest species, which are as conspicuous as a mass of fly-blows; at the same time a ring or bag net may be used to catch the butterflies; and when the caterpillars are large enough to be seen, hand-picking is neither difficult nor laborious: when they attack the seed-crops, shaking the stems might prove useful, provided troops of ducks were to follow and pick up the caterpillars; or dusting the plants with hellebore powder, fresh and genuine, would be worth a trial, as it is very effective in some instances.* After what has been stated, it is almost needless to say that the little yellow cocoons observed upon the plants and leaves, and often surrounding the caterpillars, ought never to be destroyed, as they contain a parasite which proves the cultivator's greatest friend, and the most active scourge of the turnip and cabbage caterpillars.

Even the obnoxious and persecuted wasp assists in the destruction of other insects, upon which it preys, making some amends for robbing our orchards. When at the end of summer the sweet thistle-flowers attract a variety of butterflies and swarms of insects, the wasps are busily employed in capturing them, which they do very skilfully. I have many times seen them carry off large flies from the ivy-flowers, and even the white butterflies are not too large to deter the wasps from attacking them: the species called *P. rapæ*, it seems, is most subject to their assaults, and their mode of securing this butterfly is very curious, as related by Mr. Newport, in the *Entomological Transactions.*†

On breaking off some of the turnip-leaves close to the crown in November, 1841, I found inclosed in the mid-rib (Plate D, fig. 5), three caterpillars nearly half an inch long, of a whitish colour, with a nut-brown head (fig. 6); they were evidently the larvæ of some small moth, but they both died.

CHRYSOMELA BETULÆ?

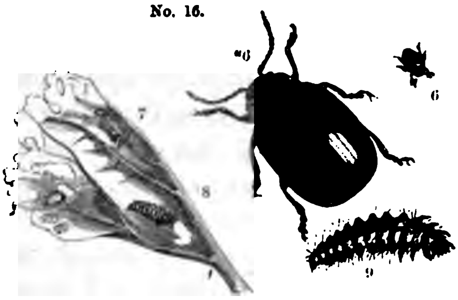
I also discovered in July, on the backs of some turnip-leaves, many

* Mr. Lymburn cleared a few hundreds of gooseberry bushes from caterpillars, at the expense of 1*s*. 3*d*. for hellebore powder, and a morning's work of two men.—*Gardeners' Chronicle*, January 1, 1842, p. 7.

† Vol. i. p. 228.

small oval eggs (Plate D; and No. 16, figs. 7), so deeply imbedded in the pulpy substance, that in many instances the cuticle had burst on the upper

No. 16.



side, so that the eggs, which were of a bright ochreous colour, were perfectly visible; the surrounding margins of the leaf were dried, and of a dark brown colour. There were multitudes of larvæ with them, which had emerged from the eggs, and were eating holes in the leaves (figs. 8.) These larvæ can crawl about, having six pectoral feet, and a proleg at the tail, the intermediate segments being very much produced, like nipples on the sides; they are of a smoky yellow colour, spotted with black; the head is black, with short antennæ and four small feelers; the first thoracic segment is dull, the second and third have four small black spots on the disk, and the following only two but larger (figs. 9, magnified); they are slightly hairy, and there is a line of brown tubercles on each side close to the spiracles, from which the animal can protrude yellow shining glands, when it is excited or put to pain: these larvæ are of course very small at first, and never attain to a large size, yet they eat innumerable holes in the leaves. I placed several upon a turnip-leaf, and believe they entered the earth to become pupæ, for they soon disappeared. There is no doubt that they change to a beetle of the genus CHRYSOMELA, which belongs to the same family as the "Turnip-fly Beetle" (*Altica nemorum*);* but it cannot leap, and it is far from improbable that these larvæ are the offspring of—

9. *Chrysomela* (*Phædon*) *betulæ*, Linn.† (No. 16, fig. 6; 6a, magnified).—A brilliant shining blue or green oval beetle, with the under side, horns, and legs black, and about 1½ line long, which I have often found upon turnip-leaves; and it has since been stated by Mr. Westwood, in the *Gardeners' Chronicle* of September 2, 1854, that "the little beetles which are attacking the white mustard crops in the fens near Ely, are the *Chrysomela betulæ*."

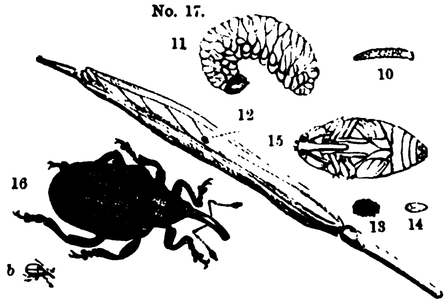
CURCULIO ASSIMILIS.—*The Turnip-seed Weevil.*

In connection with this portion of my subject, I shall only notice two other insects, both of which are injurious to the turnips when in flower and seed. The economy and habits of one were only discovered in the summer of 1841, by a friend who sent me some turnip-seed in a pill-box the end of

* Chap. i. p. 17. † Curtis's *Guide*, Gen. 433, No. 5.

June, containing also twenty or thirty maggots. On scattering the contents of the box upon a sheet of paper, the maggots stretched themselves straight out and walked very well. I was at the same time informed that a small bag of fresh rubbed-out "nimble-nine-weeks" turnip-seed was strewed in a paper tray and placed before the fire for the purpose of being well dried, when numbers of these little maggots were seen crawling amongst the seeds. On examining the seeds, however, I could not find any holes in them; I therefore placed the maggots in a pot of earth, and they soon buried themselves. About a week after this my correspondent examined some of the remaining pods of the turnip, and found one with a small hole in it (Plate D, and No. 17, figs. 12); on splitting it open it was evident that the seeds had been eaten, and it appeared that the hole had been made by a maggot in order to effect its exit. Three pods were also forwarded to me, each being punctured, and on opening them I found only one seed untouched, and two that were but slightly eroded; others were half consumed, and many entirely eaten up—a hard gummy substance of a dark colour inclosing the spot occupied by the maggots, which might be the dung compressed by the animal; but to connect these circumstances satisfactorily with the maggots, it is necessary to state that one of them was found in a pod. The maggots are fat and yellowish white; the body is formed of numerous convex muscles; the head is pale brown (figs. 10; 11, magnified); they buried themselves 2 or 3 inches beneath the surface, and inclosed themselves in brown oval cocoons (figs. 13), which were very brittle, and formed of the agglutinated grains of earth, and in one I found the pupa (figs. 14); it was of a dull ochreous tint, the eyes black, and on being magnified, the rostrum, legs, and wing-cases were very distinct (figs. 15). After remaining three weeks in this inanimate state the beetles began to hatch, and by the 21st of July nearly twenty specimens were liberated. They proved to be a small weevil which is abundant during the summer in the flowers of the turnip, cabbage, and other cruciferous plants, the wild mignonette (*Reseda lutea?*), &c., and no doubt deposits its eggs at that time in the embryo pods. It belongs to the order COLEOPTERA, of the family CURCULIONIDÆ, or Weevils, and is called by entomologists of the present day—

No. 17.



10. *Ceutorhynchus assimilis*, Payk.*—The Turnip-seed Weevil; it is

* Curtis's *Guide*, Gen. 345, No. 43.

also known as the *Curculio obstrictus* of Marsham. It is black, clothed with short white depressed hairs above and scales beneath, which give the insect a gray tinge; rostrum long, slender, and arched, smooth and naked towards the apex, furnished with two geniculated or knee'd horns, placed on each side a little beyond the middle, composed of twelve joints, the basal joint long, the seven following short and nearly globose, excepting the second and third, the terminal ones forming an ovate-conic club, hoary at the apex; eyes placed on each side at the base of the rostrum; thorax triangular, the anterior part being the narrowest and truncated, the margin reflexed, thickly and coarsely punctured, with a tubercle on each side somewhat towards the base; there is an impression down the middle terminating in a fovea behind, with a short channel in the breast to receive the rostrum in repose; elytra short and ovate, with about eight fine channels on each, the interstices punctured; wings ample; legs rather short; thighs thickish, narrowed suddenly towards the apex, the hinder have a single short tooth beneath; shanks straightish, the apex rounded and pectinated; feet four-jointed, two basal joints somewhat triangular, third bilobed, fourth slender and clavate, furnished with two claws, $1\frac{3}{4}$ line long, including the rostrum (figs. 16).

In the *Introduction to Entomology*, it is stated by one of the learned authors of that interesting and invaluable work, that a small weevil has been bred by him from the knobs or galls on the roots of the kedlock (*Sinapis arvensis*).* This little beetle is similar in form and nearly related to the foregoing insect, but it is infinitely smaller, and has been named by Marsham—

10*. *Curculio* (*Ceutorhynchus*) *contractus.*—It is black, with a coppery tinge; the head and thorax are coarsely punctured; the elytra are generally green, sometimes inclining to blue, rarely blackish; they have punctured striæ down each, with lines of minute hairs between them, and the apex is tuberculated; length, from $\frac{3}{4}$ to 1 line.

This little weevil, in the perfect or beetle state, destroys the young turnips by puncturing the leaves, as I am informed by Dr. J. W. Calvert, who thus confirms the statement in the *Introduction to Entomology*,† where it is said that almost as much damage is sometimes occasioned by this weevil, as by the turnip-fly (*Altica nemorum*); and Dr. Fleming, of Flisk, also bears testimony to the injury this curculio does to the turnip crops.

As all these weevils are so sensitive that they fall down if only approached suddenly from the flowers or leaves on which they are feeding,

* See *Kirby and Spence*, 1st edition, vol. i. p. 448, and 7th edition, p. 256.

† Ibid. 1st edition, vol. i. p. 185, and 7th edition, p. 104.

they may be easily collected, when they abound in the turnip-flowers left for seed, by shaking the stalks over a bag-net or cloth; but as they immediately unfold their legs and begin to run away after the shock is over, the contents thus collected must be swept into a pail of lime and water or urine until they can be removed and destroyed by pouring boiling water over them, for, as their horny jackets are very hard, they are not easily killed by stamping upon them.

CETONIA AURATA.—*The Green Rose-chafer.*

Another large and beautiful beetle, whose larvæ are exceedingly injurious in gardens and nurseries,* sometimes does great mischief the beginning of May to the turnips then in flower, and intended for seed, by destroying the anthers, by which means the flowers prove abortive; and as these beetles often breed amongst strawberry beds, and first attack their flowers, it is not safe to have turnips, to be reserved for seed, cultivated in a garden or in the vicinity of one where that fruit is grown, for the beetles fly well, especially in the sunshine, and after consuming the flowers in one spot they can readily fly to another for the same purpose. This handsome beetle naturally belongs to the order COLEOPTERA, and the family MELOLONTHIDÆ or CETONIDÆ, and is called Scarabæus by Linnæus, but it now bears the designation of—

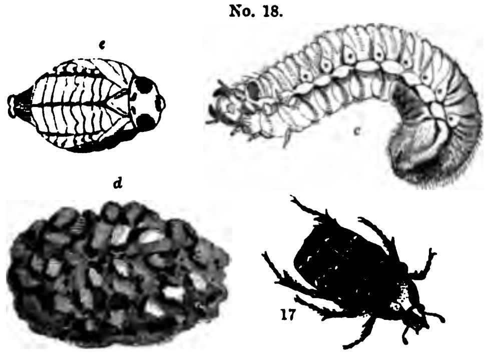
11. *Cetonia aurata*, or the Green Rose-chafer—It is of a brilliant metallic green, often having a golden or copper hue; the head is oblong, notched in front, and thickly punctured; the eyes are prominent; the horns short and ten-jointed, terminated by an oval club formed of three plates; the thorax is large, punctured, somewhat triangular or semi-ovate, the sides rounded, the base indented; the sides of the trunk have a spine on each side, which is very visible even when viewed from above; the scutellum is large and elongate-trigonate; the elytra are oblong, the shoulders project, with a scale on each side of their base, and hollowed out where the spines are; they are punctured; the suture is keeled, especially towards the apex, which is truncated, and leaves the extremity of the abdomen exposed; there are various spots upon the elytra more or less of a pure white or ochreous colour, forming transverse but irregular streaks towards the hinder part, as if the surface was cracked: the wings are very long, rusty yellow, with horny ferruginous nervures, and are folded beneath the elytra, excepting in flight; the under side is coppery, inclining to rose-colour; the face, thorax, and breast are clothed with soft ochreous down, the latter with a metallic knob projecting between the base

* *Gardeners' Chronicle* for 1841, p. 452.

of the two intermediate thighs; the legs are strong, anterior the shortest; the shanks are ciliated with ochreous hairs on the inside, the anterior are notched externally, forming three teeth, the others have a tooth outside, about the middle; they are all furnished with a pair of spines at the apex called spurs, excepting the anterior, which have only one; the feet are rather long, slender, and slightly compressed, composed of five joints, the terminal one being the longest, and producing a pair of strong claws:* length from 8 lines to more than ¾ inch (Plate D, and No. 18, figs. 17).

These beetles not only attack the flowers of the strawberries and turnips, but they may be found nestling among the petals and stamina of the white thorns, mountain ash, elder, roses, lilac, candytuft, peony, &c. The female, like the cock-chafer (***Melolontha vulgaris***),† deposits her eggs in the ground, where they hatch and produce little maggots, which live two or three years under ground, feeding upon the roots of grass and various plants until they are full grown, when they are as thick as a swan's quill, and 1½ inch long (No. 18, fig. *c*); fat and whitish, with an ochreous head; short, horny, and strong jaws; six short pectoral feet, all of a rusty ochreous colour: the body is composed of numerous rings of muscles, clothed with transverse series of ferruginous hairs, which enable the animal to progress more readily upon its back; the hinder portion is the thickest, curved, and of a lead colour, and is sparingly covered with rusty hairs; on each side of the first thoracic segment is a horny rusty spot, which readily distinguishes it from the grub of the "Great Cock-chafer," which is also hairless, with feet of a different shape. When they have arrived at their full growth, they form an oval case of earth at a considerable depth as large as a walnut, which is covered outside with the excrement of the animal, formed of oval pellets of the soil, and resembling the dung of mice (fig. *d*), and in this cell it changes to an ochreous pupa (fig. *e*). It is very remarkable that the larvæ of the green rose-chafer often live in ant-hills, without being annoyed or attacked by those hostile little animals, whence in some countries they are called "King of the Ants;" and it is also said, but it is scarcely credible, that many German cattle-dealers

No. 18.



* Curtis's *British Entomology*, Plate and fol. 374.

† Ibid. fol. 406

attribute to these grubs supernatural powers, that they feed them in boxes, believing that as they thrive, so will their cattle increase and their fortunes prosper!* It is to be hoped this was the superstition of bygone days, and that the light which has dawned upon Europe during the happy years of peace, when the arts and sciences have been cherished and cultivated, has enlightened men's minds and exposed the follies of the darker ages, when war and rapine engrossed the energies and debased the understandings of all classes.

When the sun shines and the green rose-chafers are flying about, they may easily be caught with a bag-net; but early in the morning, before they are revived by the rays of the sun, or in the evening, when they repose in the flowers, it is easy to pick off these large and conspicuous beetles; they may be collected into cans or bottles of water, and afterwards taken away and thrown into boiling water to deprive them of life.

Having often alluded to a ring or bag-net for catching insects, it may be useful to give instructions for making this instrument, which may be easily done by getting 3 or 4 feet of wire, not less than ¼ inch thick; bend the wire into a ring at least 1 foot across; the ends must then be soldered into a ferule, or made to screw or slip into one with a catch to hold it fast, at the pleasure of the maker. The ferrule must be firmly fixed at the end of a staff or stout walking-stick, 2 or 3 feet long; and a bag from 1½ to 2 feet long, made of canvas, such as ladies use for worsted-working, or that employed in cheese-presses, or any coarse gauze that will allow the air to pass through, must be sewed or fastened round the iron ring; or if a sheath of leather be first fixed round the ring, the bag may be attached to it, which will make it last longer, and it can be more readily replaced when it is worn out by sweeping herbage or other rough work. With such a net any insects may be readily caught with a little practice. The net described is adapted to brush bushes and sweep along the ground, &c.; but if one be required for catching butterflies by day, or moths in the evening, the ring must be lighter, the stick may be made of a cane or bamboo, and the bag should be of silk-gauze or bobbinet.

SUMMARY OF CHAPTER IV.

There are *three species* of white butterflies which injure the turnip and cabbage crops. The first is called the "*White Cabbage-butterfly*," which deposits its eggs in clusters on the under side of cabbage, turnip, mustard, rape, radish, horse radish, and water-cress leaves.

* Curtis's *British Entomology*, fol. 374.

When first hatched the *caterpillars* live in *society;* but when a week old they disperse.

They remain through the *winter* in the *chrysalis* state, suspended in secure retreats in walls, paling, &c.

The *caterpillars* greatly injured some *Swedish turnips* in 1841.

They do still greater mischief by eating off all the *pods,* in crops of *turnips* and *mustard* left for seed.

The full-grown *caterpillars died suddenly* of some disease after a wet night, during very hot weather.

Cabbages in gardens might be freed from this pest by *hand-picking.*

A parasitic fly, called *Microgaster glomeratus,* lives in and destroys great numbers of the caterpillars.

The *little yellow silken cases* found round the dead caterpillars should never be destroyed, as they contain these useful parasites, whose operations are certain and invaluable.

Ignorant persons destroy them, believing them to be the eggs of the caterpillars; but caterpillars never lay eggs.

The Microgaster has also a smaller parasite which lives upon it, called *Diplolepis Microgastri.*

A large ichneumon, called *Pimpla instigator,* also lives in the caterpillars of the white cabbage-butterfly.

Pteromalus brassicæ, and *P. Ponticæ,* two other minute flies, lay their eggs upon the chrysalis, and materially assist in keeping these butterflies in check; and *Polynema gracilis* punctures the eggs.

The second species, the "*Small White,*" or "*Turnip Butterfly,*" lays her eggs not in clusters, but singly, on the under side of the leaves of cabbages, turnips, mignonette, nasturtiums, &c.

The third species is the "*Rape-seed,*" or "*Green-veined White Butterfly,*" which also lays its eggs singly on cabbages, turnips, &c.

These *caterpillars* eat into the central leaves of the *cabbages,* and did great mischief in 1841.

Of all these butterflies, there are *two broods annually,* one in spring, the other in summer.

An ichneumon (*Hemiteles melanarius*) infests and destroys the pupæ.

To get rid of the cabbage-caterpillars, look for and *destroy* the *chrysalides* in winter; in the spring *crush* the clusters of *eggs, hand-pick* the *caterpillars,* and catch the butterflies in the garden.

In *seed crops* shake the stems, and let in troops of *ducks* to pick up the caterpillars as they fall down.

Hellebore powder recommended to destroy them.

TURNIP AND RAPE CROPS.

PLATE D

A White Butterfly, the caterpillars feeding on Rape and Beetles attacking the Turnip

Wasps destroy many insects, and amongst others the *white cabbage-butterflies.*

The larva of a *small moth* lives in the foot-stalks of the turnip-leaves.

The *leaves* are often *eaten* by the larva of a beetle, *Chrysomela betulæ?*

A small *maggot* lives in the *pods* of the *turnip,* eating the seeds; when full fed it eats its way out of the pod, and changes in the earth to a pupa, from which comes the weevil called *Curculio assimilis,* which inhabits the flowers of the turnip, cabbage, &c.

Another weevil, the *Curculio contractus,* punctures the turnip-leaves to a great extent.

These small *beetles* may be *collected* by shaking the flowers over a cloth.

The *green rose-chafer* seriously injures turnip flowers, by devouring the anthers, and rendering the germen abortive.

The *eggs* are laid in the ground, where they become maggots, and live three years in that state.

The conspicuous *green rose-chafer* should be collected by *hand-picking,* and killed with boiling water.

Instructions for making a *bag-net* to catch *insects.*

Explanation of Plate D.

Fig. 1. The "Rape-seed" or "Green-veined White Butterfly," represented standing.
Fig. 2*. The egg magnified.
† Two of the eggs of the natural size, laid singly on the under side of a leaf.
Fig. 3. The caterpillar of the same.
Fig. 4. The chrysalis suspended like the others.
Fig. 5. A turnip-leaf broken off to show a cavity in which a caterpillar was living.
Fig. 6. The caterpillar alluded to.
Fig. 7. The eggs of a beetle laid on the under side of a turnip-leaf.
Fig. 8. One of the larvæ feeding, which hatched from the eggs.
Fig. 9.* The same larva magnified.
a, The natural size when full grown.
Fig. 10. A maggot which lives in the pods of the turnip, and consumes the perfect seeds,
Fig. 11.* The same magnified.
Fig. 12. The aperture eaten by the maggot to get out when it has arrived at maturity.
Fig. 13. The little case which it forms in the earth.
Fig. 14. The chrysalis taken out of the case or cocoon.
Fig. 15.* The same magnified, showing the limbs, &c., of the future beetle.
Fig. 16. The turnip-seed weevil, called *Curculio assimilis,* which is the parent of the above maggot.
b, The natural size.
Fig. 17. The "Green Rose-chafer," *Cetonia aurata.*
Fig. 18. The crown of a small turnip, with all the leaves cut off excepting one.
Fig. 19. A small portion of the stem of a turnip, with two of the seed-pods remaining.

All the figures are drawn from nature, excepting 3 and 4; and the numbers with a * attached, indicate that the objects referred to are represented much larger than life.

CHAPTER V.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE TURNIP CROPS, INCLUDING THE SURFACE-CATERPILLARS, THE TURNIP-GALL WEEVIL, AND THE DIPTEROUS FLIES AND ROVE-BEETLES INFESTING ANBURY.

HAVING fully discussed the various insects which destroy the foliage, flowers, and seeds of the turnips, I shall now treat of those which principally affect the roots. Some of these may seem to do little more than disfigure the bulb, yet it is far from improbable that the most harmless of them, by first injuring the rind, may thus lead to the decomposition of the bulb, which once begun is speedily accelerated by more active agents. Among this portion of noxious insects are many large caterpillars, called by farmers and gardeners *surface-grubs*, that commit very extensive depredations upon the turnips, and likewise the wireworm, which is the most troublesome, I believe, of all insects to the agriculturist, and will shortly form the subject of a separate chapter.

THE SURFACE-GRUBS, OR SURFACE-CATERPILLARS.

Of these there are several different sorts, some less injurious than others, owing perhaps more to the paucity of their numbers than to the want of individual power to do mischief. One of our greatest philosophers was well aware of this when he said, "Insects act upon a smaller scale, but by their united energies sometimes produce great effect; the ant, by establishing her colony, and forming her magazines, often saps the foundations of the strongest buildings, and the most insignificant creatures triumph, as it were, over the grandest works of man."* It is a fact which I particularly wish to impress upon the mind of the agriculturist, that any insect feeding upon his crops may prove a great loss to him when it multiplies to excess, and this renders it most essential that he should be able to detect the first appearance of his enemies, and watch their progress; which he cannot do with certainty, unless he will make himself master of their habits, and become so well acquainted

* Sir H. Davy's *Last Days of a Philosopher*, p. 256.

with the insects affecting his crops, as to be almost able at the first glance to detect them. When this is accomplished, he may hope to learn how to deal with the enemy opposed to him, and instead of suffering a small number of destructive insects to pass unheeded, which, as we have already shown, may multiply by millions in a few weeks, he may employ his best energies to crush immediately the worm in the bud.

The surface-grubs have been noticed by authors more than a century ago; and in 1818, 1826, 1827, and 1836, but few vegetables escaped their ravages; and they occasioned so serious a loss to the farmer, that the Agricultural Society of Saffron-Walden and the Entomological Society of London, considered the subject fit for a prize essay: in 1818, which was dry, scarcely a good turnip was left by them.* The most conspicuous of these caterpillars are the offspring of the four following moths, called "the Cabbage," "the Great Yellow Underwing," "the Heart-and-Dart," and "the Common Dart:" they all belong to the order LEPIDOPTERA, and to the family NOCTUIDÆ, or night-flying moths; but when disturbed, some of them do not refuse to fly short distances by day. The caterpillar of the first of these moths, although often secreting itself at the roots of plants, seems to live upon the leaves entirely: it ought not therefore strictly to be included in this division; but it has so often been sent to me as a surface-grub, and is so intimately connected with the following species, which it appears will likewise feed upon the leaves as well as upon the roots, that I could not notice it in a better place than the present. It is included by modern naturalists in the genus MAMESTRA,† under the name of—

1. *Noctua* (*Mamestra*) *brassicæ*, Linn., or the Cabbage-moth (Plate E, fig. 1).—It is of a rich brown colour; the horns are like fine threads, the feelers are very short, and inclose a longish spiral tongue; the eyes are large and hemispherical; the wings when at rest are deflexed, namely, sloping both ways, like the roof of a house; the superior are more or less variegated with dark and light brown, having many blackish streaks upon the costal or pinion edge; there are two waved strigæ formed of two black lines near the base, and another very much crenated beyond the middle; between this and the second striga are two large black circles placed transversely, and sometimes very distinct; there is also a large spot, the shape of a human ear, margined with white, and surrounded by a black line; near to the extremity or fringed edge, which is festooned with black, runs a very sinuous line, forming a W in the middle: the inferior wings are brown, dirty white at the base, the fringe whitish, with a brown line along the centre; the body is obtuse at the apex, especially in the males, and the same colour as the

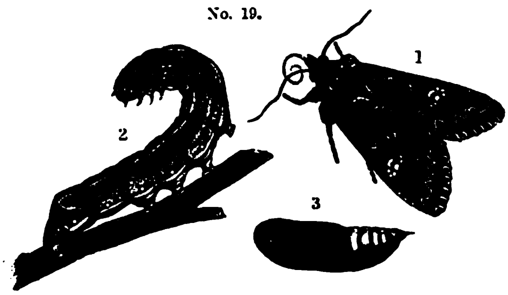
* Major's *Treatise on Insects*, p. 169.

† Curtis's *Guide*, Gen. 847, No. 7.

under wings, the extremity being sometimes ochreous, and down the back is a row of black tufts; the six legs are brown, the thighs are very woolly, the fore-shanks are short, with an internal spine; the intermediate have a pair of spurs at the apex; the hinder are long and stout, spurred at the apex, with another pair of spurs also a little removed from them; the feet are five-jointed, spotted with ochre, terminated by minute claws, having a tooth on the inside, and little lobes called pulvilli: length, $\frac{3}{4}$ inch; wings expanding $1\frac{3}{4}$ inch and upwards.

This moth is abundant in May and June; it is seen flying in the evening, and sitting in the day-time, with its wings closed (No. 19, fig. 1), on the trunks of trees, in hedges, and on the sides of clods in fields and gardens. In 1841, I bred many specimens towards the end of May, during the whole of June, and in the two first weeks of July. After having paired, the female lays her eggs upon the leaves of cabbages and other vegetables; these shortly hatch, and immediately begin feeding; they are, I believe, always green in their early stages; but when they are full-grown, being as large as a goose-quill and $1\frac{1}{4}$ inch long or upwards, they vary exceedingly in colour, some being blackish above, and variegated with flesh-colour (figs. 2), whilst others are green, slightly tinged with black above, and the spiracles white (Plate E, fig. 3); possibly these differences may be indications of the sexes; both have oblique lines on every segment down the back; the head is more or less ochreous and horny, furnished with short antennæ and jaws; the first thoracic segment is black above, and they have six pectoral, eight abdominal, and two anal feet. I know of no larva which is a more general feeder than this; some caterpillars will eat only of one plant, others of those which belong to the same natural family alone; but this can accommodate its taste as local circumstances may require to an extent which is surprising, making a meal indifferently of the saccharine maize or the acrid tobacco; the cabbage, however, is the favourite, or rather the most usual food of these animals, and I saw them very abundant upon that vegetable in company with the caterpillars of *Pontia napi*,* in July, August, and September of 1841. At the same period they were devouring the turnip-leaves, and were great enemies to lettuces and rape; they were likewise particularly fond of the

No. 19.



* Chapter iv. p. 101.

Indian corn, living amongst the male flowers, and also in the brush of filaments which crowns the female spikes, frequently eating it smooth off. I was surprised to find great numbers feeding upon the leaves of the scarlet geraniums in a large garden-bed, the beauty of the fine foliage being impaired by the multitude of large holes they had eaten in the leaves; and in October they attacked the leaves of some red currant bushes; at the same time I found them feeding freely in my breeding-cage upon the poplar, notwithstanding a cabbage-leaf was there also. Although they seem to refuse none of the productions of the field or garden, it is those of the latter which suffer most from their assaults. In the summer and early autumn months, when the cauliflowers and cabbages have a well-formed heart, these ravenous caterpillars not only consume a great portion of the plant, but render it altogether unfit for culinary purposes by the disgusting deposit which falls from them, tainting every leaf; and it is scarcely possible to detect them, unless the vegetable be cut through and even into quarters, as they eat their way into the most solid parts. This insect is abundant in all the countries of Europe where cabbages, lettuces, &c. are cultivated; and M. Godart * says, "It is extremely common in France, where it is the greatest scourge of the kitchen-gardens. It devours all the plants we cultivate, but principally the different sorts of cabbages, giving the preference to the *Brassica capitata alba* (the cauliflower). From quitting the egg until its last moult, it not only attacks the exterior leaves of that plant, but it penetrates afterwards into the heart; and as there are generally many together, they hollow it out entirely without any external indications. In countries where the tobacco is cultivated, they equally attack that plant, in spite of its acrimony." When full-grown, some bury themselves in the earth and others rest upon the surface, and change to chrysalides (No. 19, fig. 3), similar to Plate E, fig. 14, but smaller, of a chestnut colour with a pitchy shade; they are often inclosed in cases formed of the surrounding mould, and thus pass the winter securely; but many of them do not change to pupæ until April. The moths, as before stated, issue from these cells in May, June, or July.

The most certain means of getting rid of these troublesome caterpillars is to look over the plants carefully and destroy them; and as they frequently hide themselves by day under the earth, when they are in their last skins, the search might be more successfully pursued at night when they come forth to feed.

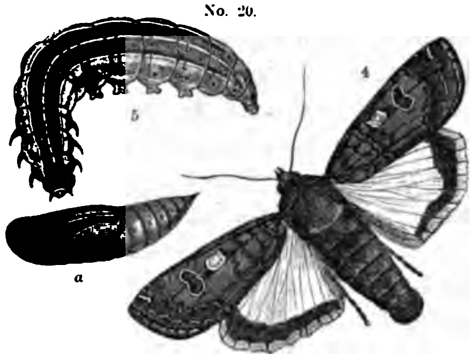
The second species now forms a portion of the genus TRIPHÆNA,† and is called—

* *Hist. Nat. des Lep. de France*, vol. vii. p. 38.

† Curtis's *Guide*, Gen. 843, and *British Entomology*, fol. and Plate 348.

2. *Noctua (Triphœna) pronuba*, Linn., the Great Yellow Underwing (Plate E, and No. 20, figs. 4).—This moth varies greatly in the colour of the thorax and the upper wings, which are sometimes of a dull ochreous or clay colour, at others of a deep chestnut brown, and there is an intermediate variety more fulvous and variegated with bright brown; the feelers are pointed, forming a beak to the head, and between them is a longish spiral tongue; the horns are slender and setaceous, like bristles; the eyes large and semiglobose; the thorax is large; the wings when at rest cover each other horizontally, being depressed; the superior are long, and have two double-waved strigæ towards the base, and another beyond the middle; on the disk are two spots, one oval, the other ear-shaped, with the centre more or less black, and towards the apex and close to the costa are two black spots; with the exception of these spots and the dark ear, the markings often vanish, as in the specimen figured; the inferior wings are ample, and of an orange colour with a blackish border, not reaching the margin, the edges being waved, broadest above, and narrowed towards the anal angle; body depressed, fulvous orange, deepest at the apex, which is broadest in the males: legs six, long and dark rusty brown; first pair of shanks short, with an internal spine; intermediate, with a longish pair of unequal spurs at the apex; hinder, long with similar spurs at the apex, and another pair near the middle, all spotted with ochre; feet long, five-jointed, and rough beneath, with rows of short bristles; claws minute, with a tooth on the inside: length upwards of an inch; wings expanding nearly 2½ inches. There is also a variety with the fore part of the thorax, the upper side of the feelers, and the costa of the superior wings, as far as the middle, of a paler colour than the other portions of those parts; this variety has been named by the German naturalists, *Triphœna innuba*.

No. 20.



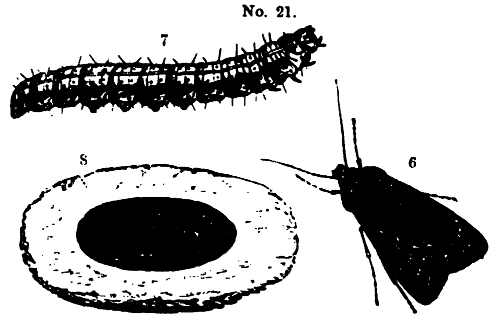
This large and beautiful moth is very abundant in most seasons during hay-making, namely, from the beginning of June to the middle of July, in fields, gardens, and hedges. On turning over the cut hay in the morning, I have seen multitudes which had sheltered there, spring up and fly a few yards, when they generally dropped down and again secreted themselves amongst the grass. I believe they are found throughout Europe, and Sir Charles Lyell observed one on Mont Blanc, the 7th of July, 1818, above the height of perpetual snow, which proves how well even the moth can resist a low temperature.

I have frequently received the caterpillars of this moth with other surface-grubs, and in November, 1841, the Rev. C. Clarke, of Henstead, in Suffolk, sent me several, which he found with others of *A. exclamationis* (Plate E, and No. 21, figs. 7) at the roots of the turnips; from which it is evident that they either feed upon the bulbs or the leaves, perhaps upon both, which is rather remarkable, because some authors state that they live upon the roots of grass, and this opinion seems to be confirmed by the moths inhabiting hay fields in such abundance; on the Continent, however, they eat many of the cruciferous plants, especially the shepherd's-purse (*Thlaspi bursa pastoris*), and they are said to be equally fond of the groundsel (*Senecio vulgaris*). These larvæ conceal themselves during the day, and come out to feed at night; they are either of a dirty-green with a coppery tinge, or of a yellowish-green, variegated on the back and sides with rosy-brown and minutely freckled; the under side is pale green; the head is ochreous, with two black stripes in front and a fuscous spot between them; the first thoracic segment has a brownish or black lunule above, but not glossy; there are three pale lines down the back, the central one being the narrowest, the other segments having a blackish streak on the inside, excepting the first four, forming seven long spots, the twelfth segment is green with four fuscous spots, and the apex is brown; the spiracles are black, the head and tail slightly hairy, and there are a few short hairs scattered over the body; they are very fat, but not in the least shining: they can walk and cling pretty well; the six pectoral feet are ochreous, the other ten have the coronets black; they are 1¾ inch long, sometimes as thick as a swan's quill (Plate E, and No. 20, figs. 5).

These caterpillars live through the winter, and can bear very severe cold; for I took one home that was imbedded in ice in December on an inundated meadow, and it not only recovered, but ate a hole in a plantain-leaf in the spring: they frequently hibernate just beneath the turf or surface of the soil, and come out again to feed in the spring; they finally bury themselves in the ground about April, when they form cases of the earth, and change to large chrysalides (No. 20, fig. *a*), of a bright reddish brown, like Plate E, fig. 14, from which the moths emerge early in the summer.

These larvæ are often alluded to by gardeners as a very troublesome species, and there seems to be good evidence of their being so, for we have shown that this variety is undoubtedly one of those surface-grubs which infest the turnips; but unscientific men are very vague in their descriptions, and often confound a number of things under the name of grubs; this is not surprising, when we are aware that nothing is more difficult than to trace these animals through their different skins and transformations, since they vary greatly in colour, live a long time, and notwithstanding the greatest care and attention they often die in the chrysalis state. If the writer be correct as to the identity of the insects, the following statements by J. D. will at once show how mischievous this caterpillar is:—"Early in May, 1833, I sowed a small bed of onions; a plentiful crop arose, but from then till September 12th the plants have kept withering until half are gone. As the herbage was in some cases wholly, in others partially eaten through at the earth's surface, it seemed clearly the work of insects; but I could find none. The bulb was partly decayed as well as eaten. Since the soaking rains which fell on September 1st, 2d, and 3d, the onions disappeared altogether at one end of the bed, and this sight prompted me, on the 14th of September, to dig the whole up. The bed was 7 feet long by 3½ wide; and in this area I found forty-seven grubs, most of them full-grown, some of them quite so, I suppose of *Noctua pronuba*."* In another place he says, "The grub of this moth is that yellowish brown, tough-skinned grub,† which every gardener has seen repeatedly on and just under the very surface of the soil, where it eats through the collar or stem of the young cabbage plants, &c., and from numerous observations I have concluded that it prefers the cruciferous plants of any or every genus to the plants of other natural orders, as the *Cruciferæ* have all, in a greater or less degree, a mustard flavour. Seven or eight years ago it destroyed, on the farm of C. Harrison, Esq., at Bury-St.-Edmund's, numerous young plants of turnips, when possessed of seven or eight leaves, by eating through their incipient root-stalks or bulbs; hereupon the plants would fall aside and die: they produced the *N. pronuba*." ‡

No. 21.



The two following very destructive species are included by our present system in the genus *Agrotis;* § their larvæ appear to be very similar, and their economy precisely the same:—

3. *Noctua* (*Agrotis*) *exclamationis*, Linn., the Heart-and-Dart Moth (Plate E, and No. 21, figs. 6), has received these names from the mark-

* *Gardener's Magazine*, vol. ix. p. 573.

† This sentence rather alludes to the larva of a *Tipula*, I should say.

‡ *Gardener's Magazine*, vol. ix. p. 504.

§ Curtis's *British Entomology*, Plate and fol. 165, and *Guide*, Gen. 834, Nos. 11 and 16.

ings of the wings resembling a note of exclamation and a heart and a dart. It is of a clay colour; the horns are like fine bristles, but in the male they appear slightly toothed like a comb, most distinctly near the base, in consequence of each joint producing a fringe of short hairs: the feelers are short and almost black beneath, with a little joint protruding at the apex, and between them is a strong spiral tongue; on the front of the thorax is a transverse black spot; the wings repose in a horizontal position, being then flat, with one of the superior lying over the other, as in the great yellow underwing; the superior wings are rather long and narrow, darkest at the costal edge, which is spotted with darker and paler marks; there are two waved double lines near the base, and to the second is attached an elliptical piceous streak; above it is a ring with a pupil, and beyond this a dark ear-shaped mark; then follows a transverse denticulated line, and nearer the fringed margin a pale and very irregular line: the inferior wings are white, excepting the upper margin and the nervures, which are brownish: the body is a little depressed, dark-brown, lighter at the base; the apex obtuse in the male, conical in the female: the six legs are long and piceous, the fore-shanks are short, and have an internal spine; the intermediate have a pair of unequal spurs at the apex, as well as the hinder, which have likewise another pair at the middle, and are ciliated outside at the base:* all the feet are five-jointed, and spiny beneath, terminating in minute claws with a tooth on the inside, and furnished with little pulvilli: the tips of the shanks and of all the tarsi are whitish. The *female* differs from the male in having simple and not pectinated horns, and the under wings are dark brown, instead of white: length, ¾ inch; expanse not quite 1¾ inch.

This moth is exceedingly abundant all over Europe, and it is even a common insect at the Cape of Good Hope. There are two broods of it annually in France, and it is found plentifully in England in June, mostly towards the end of the month, in fields and gardens, on weedy banks, &c., about which it flies at the close of day. The eggs laid by the female produce larvæ, which are said to live upon the groundsel; but that is doubtful, for a friend and myself have bred this moth from the caterpillars which were found at the roots of turnips; it is possible they feed upon both. However this may be, it is a most destructive animal to crops of this valuable plant, and sometimes, in company with the following species, destroys immense numbers at every stage of their growth. Towards the end of August, 1842, in Surrey, they attacked the margins of a field of Swedes under a hedge full of elm trees; some of the plants were observed to be dying, and on being

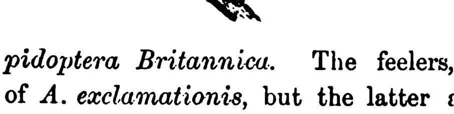
* Curtis's *British Entomology*, Plate 165, fig. 8†.

pulled up, the crown was found separated from the root, as exhibited at Plate E, fig. 8, and on searching there, one of the caterpillars was discovered; but in a neighbouring inclosure as many as four were detected at one root, and they had spread themselves into the middle of the field. This, like the other species, no doubt lives through the winter; for a friend in Suffolk supplied me with a considerable number of the caterpillars on the 20th of November, which were taken from the roots of potatoes in one of his fields.

This caterpillar (figs. 7) is of a dull lilac colour, with a broad space down the back more ochreous and lighter, the margins being bounded by an indistinct but darker line, and there is a double fuscous line down the centre; the underside is pale dull whitish-green; the head is brown; the jaws, eyes, two oblique lines at the base, and a dot between them, black, as are the nine spiracles also; the first thoracic segment is rather horny, and brown above, variegated with darker spots; the other segments have four little tubercles on the back of each, and several on the sides, all of them producing a short hair: the six pectoral legs are ochreous, the claws black, the eight abdominal and two anal feet are brown at their extremities; they are full $1\frac{1}{4}$ inch long, and as thick as a small goose quill. This is not so cylindrical as the other species are, being somewhat depressed above and flattish beneath, which is probably a better form for burrowing under the roots; they walk rapidly, but cannot stick fast by their feet, and consequently soon fall off anything they are placed upon: the chrysalis, like the others, is formed in the earth (No. 21, fig. 8).

Another species belonging to the same genus, and equally if not more destructive, is the offspring of a moth, which has been named by Ochsenheimer—

No. 22.



4. *Noctua* (*Agrotis*) *segetum*, the Common Dart-moth (Plate E, fig. 9, at rest; and No. 22, the same flying).—It is generally of a reddish-brown, but varies so greatly in the tint of the upper wings, which are sometimes of a clay colour, as well as in the strength and shape of the markings upon them, that Mr. Haworth has described it under nine different names in his *Lepidoptera Britannica.* The feelers, tongue, and horns are like those of *A. exclamationis*, but the latter are more decidedly pectinated in the males;* the wings are also placed in the same way in repose as in that

* Curtis's *British Entomology*, Plate 165, figs. 1 and 1 *b*.

species; the superior are freckled with brown, there are two double-waved lines across the base, to the second of which is attached a black oval or elliptical spot, margined with black; on the disk is a ring circled with black and dark in the centre, with a large ear-shaped spot by its side of the same tint; beyond these is a double indented and waved line, and near the margin a still more irregular one; at the base of the fringe is a row of black lunate spots: the inferior wings are pure white with an opalescent shade, the nervures and a line along the margin are fuscous; the body is brown, palest at the base; the six legs are grisly, but formed like those of *A. exclamationis*. The *female* is much darker, and the horns are simple; the head, thorax, and upper wings are deep chocolate or brown, the markings, so visible in the males, being almost obliterated in this sex: the under wings are dirty-white, softening into fuscous at the margin, the nervures being of the same colour: length from 8 lines to $\frac{3}{4}$ inch; expanse from $1\frac{3}{4}$ to 2 inches.

This moth is sometimes seen flying in multitudes about the tops of hedges soon after sunset, in June and July, and I have taken it on the sand-hills near Sandwich in the middle of October; from this it may be inferred that there are either two broods in a year, or that there is a constant succession of them during the summer and autumn months. It seems to be universally distributed, being found in almost every part of Europe, and, like the foregoing species, is equally common at the Cape of Good Hope. The females lay their eggs in the earth in the month of August, or earlier, and the young caterpillars emerge from the shells in about ten days or a fortnight, and after living through the winter they attain to the length of $1\frac{1}{2}$ or nearly 2 inches, when they are as thick as a small goose quill. They are smooth and shining, and of a pale lurid ochreous colour, faintly freckled, with a broad space down the back often rosy, and a few short hairs scattered over the body; down the centre is a double dark line, with another less distinct on each side; between these are two black dots placed obliquely on each segment, and likewise three black dots on each at the base of the thighs: like the foregoing species they have six pectoral, eight abdominal, and two anal feet: the head is horny, the mouth and little horns are rusty, the minute jaws black: the eyes are ochreous dotted with black, the internal margin being edged with the same colour, forming nearly a × on the face: the first thoracic segment is brown, divided by three pale lines; it is very horny and shining, which is much less the case in *A. exclamationis*, and not at all so in another species (Plate E, fig. 12): when disturbed they roll themselves up, but do not remain long before they are again in motion (figs. 10).

On the 7th of June, 1841, Mr. C. Parsons sent me some of these caterpillars from Essex, which were nearly full-grown; they were doing great mischief to the young mangel-wurzel plants, the roots of which they ate through just below the crown, as shown at Plate E, fig. 11; they also attacked the potatoes when just pushing out of the ground. They were exceedingly voracious, and fed freely upon lettuce-leaves which I gave them: they lived some time in a garden-pot containing a turnip-root and a potato, but eventually died, I believe, for want of more moisture. The second week of August, 1842, I received a considerable number of the same sort from a crop of Swedes in Surrey: the field had been wheat, was ploughed in the autumn, got ready for turnips, and sown all at once at the usual time. In September, 1839, a field of Swedes at Farnham, in the same county, was entirely destroyed by these caterpillars, many of which I endeavoured to rear, but they all died in the winter; they lived under ground, and ate large holes in the roots, and came out at night to feed, apparently upon the leaves. In August and September, 1835, they were exceedingly numerous in Suffolk, and did considerable injury to the bulbs of the turnips. In November, 1841, I received a considerable stock from the Rev. C. Clarke; they were then actively engaged in eating large holes in the bulbs, which, being soon filled with earth, were thereby rendered very difficult to clean, and not so beneficial to stock. At an earlier period of their lives, and about the second hoeing in July, their economy was a little varied, for they then ate off the whole crown of the plant a little below the surface, and separated it from the bulb in a similar way to Plate E, fig. 8.

These caterpillars will attack the roots of a great variety of plants, especially those of corn; from whence they are called in Germany "the Winter Corn-moth." In that country they are sometimes very destructive to the autumn-sown corn, and likewise in Russia, from whence they have spread over Poland into Northern Germany and Prussia;* and so great were their numbers at intervals, that many districts have been threatened with famine from their ravages. This caterpillar is likewise a troublesome visitor to the gardener as well as the farmer, for it not only destroys the corn and turnip crops by eating up the roots and leaves, but it attacks lettuces, spinach, beet, and also a variety of flower-roots, as auriculas, &c., doing the greatest mischief in seedling beds. Upon the Continent, as the harvest is early, these larvæ are at that period generally compelled to subsist upon the roots of grasses, but as soon as the corn shoots up in September and October they resort to the tender roots for food; and this shows how essential it is to keep the land clean, by collecting and burning the bent-grass and similar weeds, for in the absence of these it is far from improbable that the eggs would not

* Köllar's *Nat. der Schäd. Insecten*, p. 106.

be laid, or, if they were, that the caterpillars when hatched would speedily be starved to death. They pass the winter in a ball of earth the shape of an egg, formed 2 or 3 inches below the surface, in the cavity of which they are completely protected both from frost and wet. In the early spring the caterpillars leave their winter-cells and again feed, without doing much injury, until the end of May or beginning of June, when they finally enter the earth to undergo their transformation to a brown chrysalis, in which state they generally remain a month, when the moth is produced. The seasons and climate, as well as the causes already alluded to, may occasion a considerable difference in the periods when the perfect insect comes forth, for it is said that in France the moth does not appear until the end of July or the beginning of August, whereas in Austria it is recorded as hatching at the end of June or beginning of July, as it does in England.

The economy of this caterpillar has been faithfully related by a very careful observer of nature;* and as his account embodies some facts which have not come under my own observation, I cannot do better than conclude its history by transcribing his remarks:—"The grub is also a very formidable assailant in the more advanced state of the (turnip) plant, near to which it forms a round hole in a vertical direction (in appearance like that of an earth-worm, but open at the top), about 2 or 3 inches deep in the earth. At the bottom of this it remains during the day (unless it be dark and moist), and at night emerges from its burrow and commences an attack upon the plant by eating round the neck of it, and eventually detaching the upper part from the root; or a single leaf is eaten through at the stem, and when fallen on the ground, the nearest edge is dragged to the burrow, where it is drawn in and devoured during the day. Last year (1836), the turnips sown on the south side of a hill having entirely failed, it was ploughed in furrows, and each filled with yard-dung, and the earth turned over it by the plough; and on the first rainy day a number of young plants of the Swedish turnip (thinned out from a patch in a moist situation on the north side) were planted on the ridges 18 inches asunder, and very soon grew remarkably strong and healthy; but after the few straggling plants in the part left unploughed had been destroyed by the grub, then those at the extreme ends of the ridges began to disappear, and plant after plant followed from the same cause, until very few were left. Having noticed one fine plant at a distance of 6 or 7 yards from any other, and that a grub had just formed his burrow and begun to attack it, I dissolved ¼ oz. of common salt in a quart of water, and poured it over the plant, taking care not to let any run into the hole, or to

* Mr. H. Le Keux, in *Transactions of the Entomological Society*, 1837–1840, vol. ii. p. 32.

disturb the grub. When I examined the plant the following day, no further injury had been done to it, and on digging up the burrow I found it had been deserted by the grub, which I have no doubt had travelled to the next plant, although at least 6 yards distant, for there I found a burrow and a recent attack upon the plant which the day before was uninjured. I now washed this also and several others with the solution of salt, and for ten days (during which the weather was hot and dry) no one of them received further injury until a heavy shower of rain fell, after which (as I did not wash them again) they shared the fate of all the others. In such cases it might be worth while to employ children to dig them out, for they are easily found, as may appear from my having collected upwards of thirty in less than half an hour;* but the most keen searcher for, and destroyer of these is the rook, and I attribute their increase in this instance to the mistaken vigilance of the farmer in shooting any one of them which ventured to set foot upon the land, and hanging him up as a warning to his brethren of the reward they would meet with for any friendly endeavours to relieve him from the ravages of so destructive an enemy as the grub."

One cause of the great mischief arising from the attacks of the caterpillars of this and the preceding species is, their capability of travelling at a very rapid rate from one spot to another; for in this way, as soon as a caterpillar has eaten through the root of a young plant, it marches off in quest of another, and thus the evil is greatly multiplied; and on removing a little of the earth surrounding the bulb of a well-grown turnip in the autumn, ten or twelve will often be found congregated in fields that are much infested.

5. There is still another kind of these surface-grubs which I have frequently received with the others; but I cannot ascertain the species of moth it would change to, never having been able to rear one; indeed, persons living in a city, and constantly engaged in literary or scientific pursuits, have neither time nor opportunities to carry on these useful and interesting investigations with much chance of success; but those who reside in the country would be doing great service, even to science, if they would devote a little attention to the breeding of insects injurious to man; and the better to enable them to accomplish this, I will give some instructions at the end of this chapter for the rearing of the surface-grubs. But to resume the subject. These caterpillars (Plate E, fig. 12) are full-grown the beginning of September, and feed upon the roots of turnips in fields: they ate off the crown close to the top, as shown at fig. 8, and in the garden they injured the roots of the

* It appears that Lord Suffolk "cleared a field of eight acres of Swedes by hand-picking: a boy followed each hoer and collected upwards of 1000 daily. Above 16,000 were picked up at an expenso of less than two shillings per acre."

cabbages, it was said, by gnawing all round the stem just below the surface. One was found in earthing up celery: this was left upon the ground a few seconds, when it disappeared, and on digging it was ascertained to have buried itself in that short space of time about 1 foot deep. This surface-grub is very ravenous, for two that were confined in a pill-box, where one changed its skin, were eating the soft part of the exuvia when I chanced to look at them; they even appeared to be disputing for it, and in a short time the whole was entirely devoured: I afterwards gave them a cabbage-leaf, which they ate very readily. They were of a pale-green colour, somewhat flesh-coloured on the back and lightly freckled, with a double line down the centre, the space between the lines whitish, a similar line extending along each side near the base of the thighs; the spiracles are black, and on the back of each segment are four black dots, the first pair approaching; the head is horny and ochreous, with a black spot on each eye, near the base of the jaws, which are rusty, and a black furcate mark on the crown; there is no horny covering to the first thoracic segment, which distinguishes it at once from the foregoing species; the feet are sixteen, as usual in this family: these caterpillars are as thick as a goose quill, and about 2 inches long; they can walk backward with perfect ease, a power which enables them to sally from their burrows more readily, and when touched they coil themselves up. In the month of March following I examined the mould and found they had formed thick oval cases of earth, with a cavity inside (fig. 13), in which they had changed to bright-brown pupæ; the tail terminated by two slender spines, with heads like pins, and a row of spiracles or breathing pores down each side (fig. 14).

There seem to be very few, if any, intervals of the year, when some of these surface-grubs are not at work; they consequently become very formidable enemies to the turnip crops where they abound: in the summer it is evident that they destroy the young plants by separating the crown from the root, and in the autumn and in mild winters they eat large cavities in the bulbs, which, besides making them less wholesome food for stock, reduce their weight, and render them more subject to decay, from the alternate effects of wet and frost: those caterpillars, likewise, which live through the winter and come out to feed in the spring, are ready to attack any young crop that may be conveniently reached by them.

I shall now lay before the agriculturist the various methods that have been suggested for the destruction of these caterpillars, for whilst in the egg state, which appears to be seldom earlier than midsummer, the fields are producing their crops; it is therefore at least inconvenient to attempt, if not impracticable, to do any good, except perhaps on fallows, by ploughing, harrowing, and working the soil, which must be one of the most effectual means of rendering the attacks of most, if not of all, insects abortive, at least after the first assault, for nowhere do they increase and luxuriate more than on neglected and slovenly cultivated lands. Like many other wild animals they will multiply greatly in a favourite spot if unmolested; but when harassed and disturbed, they will depart for a more eligible locality. Neatness, therefore, and constant attention to the crops, are as essential in the field as in the garden, and they will be attended with the same beneficial results as care and cleanliness insure in the fold and stable when bestowed upon our stock and teams. There is likewise little doubt, from the astonishing sagacity which insects exhibit, that the females would only lay their eggs in fields where there was a fair prospect of the young caterpillars finding at once the food necessary for their sustenance; for so perfect is their instinct, that a butterfly will traverse a wood in every direction to find a leaf of the tree on which alone her caterpillars will feed. This is very astonishing, for what impulse can lead the butterfly, which for her own nourishment only extracts nectar from flowers, to a certain kind of tree, there to deposit her eggs upon the most sheltered part of the foliage? * It is undoubtedly the Divine law of the Creator which directs the insect in its ways as well as the planet in its course!

As it appears to be impracticable to destroy the eggs, we must attack these creatures when they are in the caterpillar or feeding state, and even at that period of their existence we know nothing at present, until they are more than half-grown, and their presence is only detected by the mischief they are doing. Even then it is difficult, as it is in most cases, to apply a *certain* remedy; but as they come out only in the evening, to feed during the night, lying concealed by day in the earth or under clods, stones, and rubbish, it is evident that the proper time to apply any destructive liquids and powders must be after sunset. Tobacco-water will, for instance, kill the surface-caterpillars, if it come fairly in contact with their skins; but if the turnips were profusely watered with that liquor in the daytime, I suspect it would not destroy a decimal part, since those in the earth would descend to a greater depth as soon as they detected the hateful shower.

Bouché says that in a garden the only remedy, which is a very troublesome one, is to search for and kill these caterpillars. Köllar also believes

* I was in an extensive wood in April, 1841, where I saw only *one tree* of the alder-buckthorn, *Rhamnus Frangula*; hovering about it I observed a female brimstone-butterfly, *Gonepteryx rhamni*, the larva of which feeds only upon that and the common buckthorn. She seemed to have some difficulty in selecting a proper leaf, but having done so, she bent her body and deposited an egg on the under side; and although I went within a few inches of her to witness the operation, nothing could divert her from her purpose, but immediately after she flew away.

the best method is to collect them into pots and kill them with hot water, when the tub, which may be placed where most convenient in the field, is sufficiently full, or the labour is ended; of course the vessel must be closely covered to prevent their escape. The value of being acquainted with the habits of insects is very manifest with regard to these caterpillars, for any one ignorant of their economy might search for them in vain. The best plan to be adopted will be to turn over the stones and clods by day, and to pick them off the plants after sunset with a lantern; and occasionally they may be found in the day, when they leave their hiding-places to change their skins or to fix on a suitable spot to undergo their transformation to a chrysalis. Köllar remarks that the operation of collecting, like all others of a similar nature, should be simultaneous on a farm or in a parish, and requires the united force of the neighbourhood, without which, anything like extirpation cannot be effected. When turnips or cabbage plants have been bitten off in the night, the soil should be removed as soon as possible from the stem or root, to the depth of an inch or two, where the enemy will generally be found secreted and enjoying his repose.

Mr. Denyers recommends laying dry soot 1 inch thick over the ground and digging it in:—"In the grub's attacks on plants of the cabbage family, its habit is to eat some nearly and others quite asunder, a little below the heart: it often greatly annoys the farmers in their turnip-fields. I have made use of the above remedy and have never found it fail." * Mr. Mathers also says—"In May, 1829, my plants of cauliflowers and cabbages were all going off by the grub, which had totally destroyed the lower part of the root; but by applying a small handful of soot to the stem of each and earthing them up immediately, they threw out fresh fibres, which very much astonished me, and the plants grew more rapidly and made very fine heads." † From these reports it seems that soot is very offensive to the surface-grubs, and most probably would be very beneficial at the early stages of the turnips, but we fear it is too difficult to procure in sufficient quantities, as well as too expensive, for field culture.

Another correspondent in the same journal says—"The brown grub is a mortal enemy to lettuce, celery, and all the cabbage tribe; wherever their depredations are observed, dig below the eaten plant, find the insect, and destroy it, otherwise another plant will be devoured on the morrow. A little fresh slaked lime laid round each plant will defend it, unless the grub rises directly from below." ‡ At a meeting of the Entomological Society in December, 1836, specimens of the caterpillar of *Agrotis segetum* were

* *Gardener's Magazine*, vol. ix. p. 573. † Ibid. vol. vii. p. 87. ‡ Ibid. vol. iv. p. 187.

exhibited by Mr. Yarrell, "which had been forwarded to him from Saffron-Walden, where they had been very destructive to the turnips, five or six attacking the roots of that and other kinds of plants. Mr. Scales also exhibited larvæ of apparently the same insect, which had been equally destructive in his garden at Stoke-Newington, the caterpillars coming abroad at night and eating round the roots and vegetables just at the surface of the ground." * In November, 1835, Mr. Hope stated, at a meeting of the same society, that the larvæ of an Agrotis had proved very injurious to the turnips in Shropshire, Herefordshire, and Worcestershire, hiding themselves in the ground in the day-time and coming forth at night to feed upon the leaves. "He suggested that the application of quicklime over the turnips after rain at dusk would have the effect of destroying the larvæ when they came forth to feed, and likewise that it would be serviceable to turn poultry and ducks into the fields when ploughed." †

Mr. Major ‡ says that, on a small scale or in the garden, their ravages may be mitigated by clearing the ground well of all weeds or other vegetation a week or fortnight previous to sowing the seed or pricking out a bed, which will cause the caterpillars to leave it in search of food. He proposes also planting a decoy for them by surrounding the seed plot with a row of cauliflowers, cole, broccoli, or any similar vegetables which can be spared; of course if any of the larvæ be there they will be attracted to the plants, and by searching daily a few inches below the surface they may be readily detected and destroyed. As soon as a leaf of the young plant dies or the top droops, immediately turn up the earth with a trowel, and the enemy will be found at the root; but if this be neglected only for a few hours, he will have departed to another plant. He also recommends mixing 1 lb. of soap with 16 gallons of water, and applying it in a warm state to the roots, until it sinks into their burrows. "This will cause them to dart out of their cells with their heads upwards, where they stand perpendicularly as if they were completely killed; they must however be quickly collected, as they will recover in ten or fifteen minutes and retire again." He adds, "that the only remedy favourable to extensive crops will be, instead of shooting and frightening the rooks, to use every encouragement to induce them to resort there, that they may gather the grub for sustenance." If this favours the small birds also, which he thinks gather the seed and eat the heads of the plants, the mischief may be averted by dusting them over with quicklime while the dew is upon the leaves; this should be done as soon as the plants appear above ground, and ought to be repeated in two or three days. The rooks are often

* *Transactions of the Entomological Society*, vol. ii. p. xxx. † Ibid. vol. i. p. lxxvii.

‡ *Treatise on Insects*, p. 169.

accused of doing great mischief to crops attacked by the grub, for they not only search at the roots of the infested plants, it is said, but they pull up all as they go. The rook is so sagacious that I would fain release him from this accusation: when he thus pulls the plants about I suspect that slugs, wire-worms, and grubs are at the roots; if he did not kill them, the plants must die, and without his aid the insects would remain; it is therefore clear that the farmer is a gainer by his services, inasmuch as he gets rid of the vermin which infest the soil, so that at all events his succeeding crops will be free from their attacks. To ascertain the real value of the services of birds in keeping under noxious insects, let any one kill them all off if possible, and the reward of his folly will be a dearth on his land. If the rook does live sometimes at the farmer's expense, let him not forget "that the labourer is worthy of his hire."

Pigs are also very fond of the grubs, and these, as well as ground-nuts and other roots, afford them a fine feast on waste lands, and cause them to root up the ground: whether they could be safely employed to search for the surface-grubs is questionable; if they might, I think they would prove most serviceable agents in their destruction when fields are swarming with them late in the year.

The chrysalides are so securely enveloped in a ball of earth, the cavity being smoothed perhaps by some fluid from the mouth or body of the caterpillar, that it is probably unaffected by the sharpest frosts and impervious to the heaviest rains; it is therefore useless to attempt to destroy them in that tranquil state by watering or dusting; and catching and destroying the moths, if practicable, would not be an effectual remedy, for the females would escape the strictest search, their colours being so grave and similar to the earth, that no one could discover them when at rest in the day-time; and fires or other means employed at night to attract and destroy the moths would only reduce the number of *males*, leaving the females, which seldom fly, and a sufficient number of their mates, to supply the succeeding generations.

Although the following remedies apply to corn crops when attacked by the surface-caterpillars, I shall introduce them here, as they may bear in some measure upon the turnips, and guide the farmer when they visit his lands.

Late sowing, as it regards corn, would prove the best security in autumn, because the larvæ would in all probability be starved to death before the roots of the corn were ready for them, and it is believed that the female moth takes advantage of a fresh ploughed field to deposit her eggs in the soft and moist earth; if this be the case, June and July are the most improper months for sowing turnips, so far as regards these caterpillars. The richer the soil,

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the warmer the situation, and the earlier corn is sown, the more are the attacks of the surface-caterpillars to be dreaded, as they immediately destroy the immature roots of spring corn. Soils rendered strong and warm by horse-dung manure are most infested by all sorts of larvæ and worms, which is supposed to arise from the heat that is generated by the fermentation accelerating the hatching of the eggs.

Steeping the seeds in liquor extracted from bitter herbs,* mixed with salt or nitrates, can be of no use, unless, by forcing the germinating power, the plants are enabled to outgrow the injuries they have sustained. If any salts, especially nitrate of ammonia, were mixed in sufficient quantities with the soil, there can be no doubt of their securing the crops, and, thus applied, liquid manure might prove most beneficial. Köllar expresses a fear that, if the seeds were rendered bitter and disagreeable to the insects, the same properties would be communicated to the grain, thereby making it unfit for use, but this opinion is not supported either by physiology or experience.

The Royal Academy of Sciences in Sweden† recommended ⅛th of a ton of slaked lime to be sifted over 1 ton of wheat when spread out, and to be well mixed with it; the whole is then to be tied up tightly in sacks and laid under the straw in the barn for three days, until the wheat becomes thoroughly heated, after which the corn and lime may be sown together in calm weather. Scattering ashes immediately before and after sowing the seed, or when the plants begin to shoot up, might prevent these caterpillars from attacking a crop, or drive them away. The same society states, on the authority of many farmers, that corn has been effectually protected from seed-eating caterpillars by sticking inverted young fir trees, having the tops first cut off, into various parts of the field! If this be correct, we are at a loss for an explanation of the phenomenon; yet it is maintained, so certain is the effect, that if the caterpillars had already infested a field it would cause them to vanish.

Köllar is of opinion that the advantages derived from sowing hemp round the borders of a field do not arise from any disagreeable scent being imparted, but from its attracting small birds, which resort to it for its seed and for shelter, and, by feeding upon the hurtful insects around them, they greatly diminish their numbers. It is difficult to account for the absence of the surface-caterpillars from our field crops for many years together, unless, as is generally the case, they are occasionally overpowered by parasitic insects; it is therefore not a little remarkable that I have never met with any of the

* Mr. Main states, that "watering April-sown cauliflower seedlings with an infusion of the leaves of artichokes, a liquor bitter enough, will not preserve them."—See the *Gardener's Magazine.*

† Köllar's *Naturg. der Schäd. Insect.*, p. 111.

parasites which we may presume are attached to these caterpillars; it is true that, as far as regards the *Noctua brassicæ*, I find in gardens in June and July great numbers of an ichneumon, called *Exetastes osculatorius* of Fabricius,* which appears to accompany that species, but, never having bred it, I have no direct evidence of their being connected in their economy. There are, however, a vast number of beetles called ground-beetles, of the family CARABIDÆ, which abound in fields and pasture lands, and no doubt contribute largely in the reduction of less powerful insects, for they are almost all carnivorous, feeding on caterpillars and other larvæ, as well as on worms; one of these is named—

5*. *Omaseus melanarius*, of Illiger.—It is a large beetle, which attacks and devours the surface-caterpillars in turnip fields; it resides under clods and stones, coming out at night to prey, and one of them has devoured six or seven small caterpillars in a night. It varies in size from 7 to 12 lines; is shining black; the head is furnished with a pair of sharp strong jaws, and two eleven-jointed, thread-like horns: the eyes are small, but prominent; the thorax is heart-shaped, cut off before and behind, with a channel down the back, and two rough pits at the hinder angles: the elytra are broad, elliptical, with sixteen longitudinal furrows; wings none; six strong legs, the fore-feet broadest in the males.

The larvæ of this beetle are by no means uncommon in fields and gardens in the spring; they are about 1 inch long, brown and ochreous, and are frequently infested by a parasite called *Proctotrupes viator*,† these larvæ form an oval cell of earth, deep below the surface, in which they change to pupæ, and from one of these I bred the beetle (*O. melanarius*) in June.

I shall conclude the history of the surface-caterpillars by giving directions for the rearing them, trusting that it may lead us to a better knowledge of some parts of their history. When we take any caterpillar or other larva of an insect from the field or garden, the nearer we can approach to keeping it in its natural state, the better chance we shall have of rearing the perfect insect, whether moth, fly, or otherwise: the first object is therefore to plant the food it requires in the right soil; but if the larva feed upon the leaves or flowers of a tree or plant, a twig may be cut off and placed in a vial or small bottle of water in the cage: the next thing is to keep the earth inclosed sufficiently damp but not too wet, and this is most difficult. The best mode undoubtedly is to take a butter-firkin or small useless box, and bore the head or bottom full of holes, which are necessary to drain it, but not large enough to allow the animals to get through; then sink the barrel

* Curtis's *Guide*, Gen. 524, No. 15.

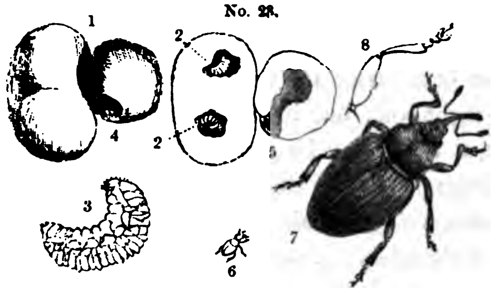
† See *Gardeners' Chronicle*, vol. vi. p. 36.

in a shady yet airy spot in the garden, within 6 or 8 inches of the surface: this being done, fill it with the proper soil to the same level, so as to leave enough space for the growth of the turnip, potato, corn, or whatever is required for the sustenance of the larvæ; if the sun shine upon it, it will be necessary to shade the plant a day or two from the heat and light by inverting a garden-pot over it, the larvæ may then be put in, and the top must be closed, either by a cover made of wire-gauze, strained over a frame and fitting close into the top, or coarse canvas may be substituted: and it will give more room for the food to grow up, if two pieces of cane or willow-twigs be tied together forming a cross, and the four ends bent down inside of the barrel, over which the canvas may be tied; the great objection to this material is, that it soon rots when exposed to the weather. Some twigs or dead bushes should be stuck round to keep off cats, &c., and the lid or covering must be opened from time to time to see what is going on. Of course such objects as the larvæ live amongst in a natural state ought to be introduced, otherwise they will frequently die for want of the proper materials to form their cocoons; moss, dead leaves, old bark, rotten wood, green turf, &c., are often required. By the method here recommended the magnificent death's-head moth,* which feeds upon potato-leaves whilst a caterpillar, has been bred with tolerable certainty, but these insects have almost always died after passing into the chrysalis state when fed in any other way, and I doubt not that the economy of the wire-worm might be completely developed by pursuing the same treatment.

CURCULIO PLEUROSTIGMA—*The Turnip-gall Weevil.*

The excrescences (No. 23, fig. 1) which frequently disfigure the turnip-bulbs, and are not confined to any particular variety, on being opened will be found to contain a small maggot (figs. 2; magnified at fig. 3), something like that which we represented in Plate D, fig. 10, but it is thicker: these galls, or knobs, as they are generally called,† vary greatly in bulk, from the size of a pea to that of a large acorn; the smaller ones contain a single maggot, the larger excrescences several, as shown by the cavities laid open

No. 23.



* Curtis's *British Entomology*, fol. and Plate 147.

† Anbury is sometimes improperly applied to this malformation.

at fig. 5.* My friend Mr. Spence† having bred the weevil from these galls, we may conclude that, soon after the turnip-bulb is formed, the impregnated female pierces a hole through the rind with her proboscis and deposits an egg in it, which shortly hatches, and the young maggot feeds upon the internal substance of the bulb; the excrescences are produced most probably, as in other similar cases, by the injection of some fluid into the wound when the egg is deposited, to form a proper nidus for the embryo young, or it may be the effect of an acid secretion of the maggot. Naturalists are yet ignorant of many particulars relating to the history of this beetle, for, although the galls are visible upon the turnips from the close of summer until the opening of spring, the maggots in all probability are not many weeks in arriving at maturity. I have found them of all sizes in winter, but never met with one in the pupa state; I therefore conclude that, like the turnip-seed weevil,‡ they eat their way out (fig. 4), and enter the earth to undergo their final transformation.

The maggots are fat and whitish (figs. 2; magnified at fig. 3), often of a bright flesh colour, when they live on the Swedes, wrinkled, especially on the sides: head ochreous: jaws bright nut-brown, the extremities black, as well as a minute eye on each side; when at rest and in their cells they generally lie curled up, and are not able to extend themselves and walk like the maggots of the turnip-seed beetle, but when forcibly stretched out they are about ¼ inch long. After their metamorphoses in the earth, a beetle is eventually produced which naturally belongs to the order COLEOPTERA, and the family CURCULIONIDÆ. It is designated in modern works as the—

6. *Curculio (Ceutorhynchus) pleurostigma;* it is also the *Rhynchænus sulcicollis* of Gyllenhal; § the Turnip-gall Weevil.—It is black and shining; antennæ inserted at the middle of the rostrum, which is long, slender, curved, and punctured at the base; the former are geniculated and twelve-jointed, the basal joint is long and clubbed; second and third elongated, fourth and fifth oblong, three following globose; the remainder forming an ovate-conic club; head with an impression between the eyes, and, as well as the thorax, is coarsely punctured, with short whitish depressed hairs; the latter is triangular, truncated, and narrowed before, the sides being hollowed, forming a small tubercle on each; the anterior margin reflexed, the lobes ochreous beneath; there is a broadish channel down the back, and a short groove in the breast; scutel minute and depressed; elytra semi-ovate, with ten clean

* I found four larvæ in one excrescence on the 9th of November.

† Kirby and Spence's *Introd. to Entom.*, 1st edition, vol. i. p. 450, and 7th edition, p. 256. The roots of the charlock and cabbages are similarly affected, but by other species of the same genus.

‡ Chapter iv. p. 104.

§ Curtis's *Guide*, Gen. 345, No. 37; and *British Entomology*, fol. and Plate 670.

cut striæ on each; the interstices scabrose, and sparingly clothed with short whitish hairs; the apex roughish; wings two, and ample, folded and concealed beneath the cases; under side speckled with whitish ochreous scales; the pleuræ ochreous white: six legs equal, with whitish depressed hairs; thighs stout, with a small pilose tooth on the under side of each (fig. 8); shanks stoutish; feet four-jointed, two basal joints trigonate, third broad, bilobed, fourth slender, longer, and clavate, terminated by two simple claws; length, including the rostrum, 1¼ line (fig. 6; 7, magnified).

This beetle is very similar to the turnip-seed weevil (Plate D, fig. 16); but it is black instead of gray; the wing cases are not so rough or strongly tuberculated at their extremities, and *all* the thighs have a small tooth beneath. It is not uncommon in hedges and waste grounds, from the commencement of May to the end of August; and closely contracts all its members when alarmed, at which time it looks like a black seed. It no doubt lives in flowers, like its congeners; but no means could be devised for the destruction of this insect, which fortunately is not of much consequence, for, excepting the beauty and symmetry of the bulbs being affected, the turnips are, I apprehend, in no way injured by their presence. We may, however, mention, that partridges are very fond of the maggots, and that is undoubtedly one reason for the turnips being so attractive to those birds; they are there under cover, and run about in search of the galls, to pick out the hidden maggots, and probably others whose history I shall now proceed to relate.

ANBURY, OR FINGERS-AND-TOES.

That these malformations are occasioned by insects I very much doubt; yet it is unquestionably true that the bulbs of the turnips, when thus affected, are inhabited by multitudes of maggots, beetles, &c., but then they are either such as obtain their sustenance from putrid substances, or those beetles which are carnivorous, and are attracted to such spots by the abundant supply of food which the helpless inhabitants of the diseased roots afford them. I therefore consider insects to be not the cause but the effect of anbury, although their united efforts contribute in no small degree to the more speedy dissolution of the bulbs.

The above are, I believe, two distinct diseases: but as it is very difficult to distinguish them by the published accounts of authors, I am not able to characterize them separately. The "fingers-and-toes" I had always supposed to be the division of the root into a number of thick appendages at the expense of the bulb; but "anbury," instead of producing radish-like appendages, is characterized by a knotted and irregular growth of the fibres.

Mr. Dickson says of fingers-and-toes:—"It occasionally happens that turnip-plants, instead of swelling and forming bulbs, send off numerous stringy roots, which soon decay, and come to no account. It occurs most generally when the crop is sown on fresh land, and no remedy is said yet to have been discovered to prevent it. More perfect tillage, and the use of such manures as have a tendency to render such lands more mellow and friable, may perhaps be beneficial."* Mr. Marshall, in allusion to the anbury, says that it is a large excrescence produced below the apple or bulb; and when this was just forming, and not larger than a green walnut, the anburies were as large as a goose's egg, awkward, and irregular in form, with excrescences below, not unlike races of ginger, depending from them. After arriving at maturity, they exhibit a putrid fermentation, and emit a most offensive scent. When the anburies are divided they are hard; but, with the assistance of a lens, veins or string-like vessels may be seen dispersed through the tumour. When turnips are affected with this disease, the tops become yellow and flag in the heat of the sun, and they are thus readily distinguished. He says it has been attributed to the land being too long continued under this green crop; but it is certain the anbury appears on land where turnips had never been grown before: he, however, considers that it proceeds from the puncture of an insect in the vessels of the tap-root, by which the course of the sap is diverted, and instead of the natural bulb an excrescence is produced. He recommends that the diseased plants should be removed as soon as possible, and the earth stirred about those that remain; and he adds that it may be wholly avoided by well preparing and richly manuring lands subject to produce anbury.† I have heard that a naked fallow is a remedy for it; but it is well known that marl is the great cure, and Norfolk marl is said to be the best. On a sandy loam in Suffolk, where anbury constantly made its appearance after the second hoeing, the application of chalk proved a certain cure, and the gentleman ‡ to whom I am indebted for this information found that if, instead of growing turnips the fourth year, the crop be changed for four years more, the disease was completely eradicated. Teathing the barley-stubble which is intended for turnips will cause the anbury: if this be avoided, the good effects of marl and chalk will be felt for many years.

Whether wet or dry seasons be most favourable to anbury I cannot determine. Farmers are of opinion that the latter are the worst; and Mr. Sinclair says that when the disease has taken place, if plentiful rains ensue, the bulbs put out other roots, or rather small fibres enlarge, to supply the places of those which are wounded.§ The autumn of 1841 was wet enough, yet in

* *Practical Agric.*, vol. ii. p. 666.

† *Rural Economy of Norfolk*, vol. ii. p. 33.

‡ Mr. J. Robinson, of Henstead, Suffolk.

§ *Memoirs of Caledonian Horticultural Society.*

Suffolk I found the turnips on a part of the coast suffering severely from anbury in the beginning of November. There were in one field four different sorts of turnips growing: the long-pudding, which seemed to be the worst affected, as the tap-root was generally completely rotten in the earth; the odour was most offensive; and on opening the wet and carious parts there were numbers of maggots in groups of five or six together, completely imbedded in the putrescent substance. I sometimes found as many as twenty in one root. I observed with them some minute *Acari*, both red and whitish, with quantities of small rove-beetles with their larvæ, and a few large carnivorous beetles. The branching roots were covered with simple or granulated excrescences, but *they* were not decaying. The Scotch yellow turnips had grown to a good size; but the tap-root frequently produced a tumour as large as a pullet's egg. On cutting them open I found them solid, and, with the exception of a few small holes eaten here and there, which were like the erosions of the wire-worm, of which I detected one, they did not exhibit the slightest signs of any insects inhabiting them, even in an embryo state: the centre of the tumours was discoloured, and the texture perfectly fibrous or woody. The Swedes, as well as the round white turnips, were but slightly affected. I likewise remember examining, in August, 1841, at least a dozen young cabbage-plants with clubbed roots as large as a child's fist, but could not find a single maggot anywhere, and the tumours were sound and solid.

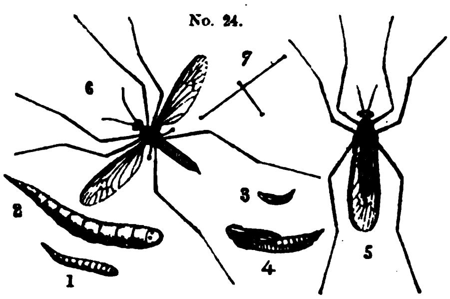
I think from the above evidence it is pretty clear that certain conditions of the soil, induced probably by the repetition of certain crops, and not insects, are the cause of anbury:* the enlargement of the lateral roots, which become woody, stops the flow of sap to the bulb; it consequently ceases to draw nourishment from the soil, when it dies and rots in the earth, and becomes a fit nidus for a variety of insects. With regard to fingers-and-toes, if that disease be the malformation I take it for, it arises possibly from the land not having been sufficiently prepared for the turnip crop; but this is an opinion which I venture with great deference to offer for the consideration of the practical cultivator.

It will now be necessary to give the histories of the insects alluded to which inhabit the anbury. The most important of them is the maggot of a delicate gnat, which, as I have already stated, lives in small families in the putrid and moist portions of the bulb (No. 24, fig. 1). These larvæ are slender, cylindrical, shining, and pale yellow (fig. 2, magnified): they taper gra-

* If cabbages be planted, or the seed sown, for several years following, upon the same land, the roots get knotty and the heads become smaller; but if cultivators would procure strong and healthy plants from a market-garden, instead of sowing their own seed, it would do much towards obviating this mischievous disease.

dually to the head, which is very pointed, with two black lines on the crown, and two horny spines or jaws at the mouth: the body is composed of about twelve segments, thickening towards the tail, which is blunt and rounded, with two brown spots, being the tips of two tubercles: they are about 5 lines, or not quite ½ inch long. When full-grown in November, I placed them, with the diseased root they inhabited, in a garden-pot with mould, and in the following April a great number of female gnats had hatched, but were all dead; they therefore must have come forth at an earlier period: the empty pupæ-cases were lying about, but I could not find one unhatched, which I am led to regret, because even De Geer was unacquainted with the economy of this insect.* The empty cases were pale dirty ochreous, exhibiting the forms of the different members of the imago; they were a little arched, the tail was pointed, with two parallel spines at the tip, and two short-pointed teeth above them. The gnats are often seen resting upon the inside of our windows in the winter, especially after the breaking up of frosts, and in calm days they fly in troops in fields and gardens, dancing together in the air without separating, and during the severest frosts these fragile flies, which are so delicate that one would imagine a breath, much more a northern blast, would annihilate them, may be found standing upon the sides of walls in damp gardens as unaffected apparently by cold as in the finest days of spring. Six species have been found in England;† and one of them has been bred from putrid *fungi* by Mr. Haliday. These gnats belong to the order DIPTERA, and to the family TIPULIDÆ; they form a genus called by Meigen TRICHOCERA: the species infesting the turnips is named by the Baron de Geer—

No. 24.



7. *T. hiemalis*, the Winter Turnip-gnat.—The males are smaller than the females, and are distinguished by the structure of the tail: they are of an ash colour, the head is small and globular, with two lateral black eyes; the neck is slender; the mouth forms a little beak; the feelers are distinct, incurved, and five-jointed; the horns are longish, pubescent, setaceous, being very slender at the tips, composed of many joints, the two basal globose, third the longest, the remainder elongated; thorax oval, cinereous, with four fuscous stripes; body cylindric, pubescent, the apex obtuse in the male, with two incurved appendages, forming a pair of forceps; more conical in the

* I have since obtained the pupæ, see fig. 3; 4, magnified.

† Curtis's *Guide*, Gen. 1165.

female; with two parallel black hooks bent down like a claw at the apex, and forming the ovipositor; wings incumbent in repose (fig. 5), ample, much longer than the body, glassy, iridescent, slightly stained with yellow, having numerous longitudinal nervures, forming one discoidal and seven posterior cells; balancers pale, the club fuscous; six legs long, very slender, and pubescent; thighs long, shanks longer, especially the hinder; feet long, five-jointed, basal joint very long, fourth and fifth elliptical, the latter furnished with two minute claws and suckers: length, 3½ lines; expanse of wings, 6¾ lines; (fig. 6, flying; 7, natural dimensions.)

The *Acari*, or mites found with the maggots, were the size of a grain of sand; most of them were reddish brown, but some, which were smaller and younger, were whitish: the two feelers and eight legs were hairy and pale ochreous. They probably had been introduced by the large rove-beetles, which are often infested by these parasites; and they may attack the various larvæ inhabiting the turnips, and perhaps destroy the eggs from which they are produced; but these are only conjectures.* On another occasion I examined some diseased and enlarged cabbage stalks at the end of May, and on opening one of the galls, which was soft, I found it filled with a white acarus; the four hinder legs were much smaller than the others, and the tips were furnished with a single claw.

There is frequently a variety of rove-beetles in rotten turnips, principally of the genera *Aleochara*† and *Oxytelus;*‡ their habits are similar, being constantly found in decomposing animal and vegetable substances: when turnips have what is termed a "grubbed" appearance, it has been attributed to the larvæ of these little beetles; and Sir Joseph Banks stated that forty or fifty of the larvæ of a *Staphylinus* had been discovered in October just below the leaves in a single bulb.§ I also received specimens of the above genera from the Rev. T. H. Scott, of Whitfield rectory, near Heydon-Bridge, Northumberland. They made their appearance about the beginning of July; and on hoeing the turnips they were observed about the roots, and were gnawing them. This is remarkable; for two of these beetles lived three months upon maggots found in some turnips.‖ It is not the turnips alone that are infested by this tribe of insects; for this, or a similar larva to the above, sometimes does great mischief to wheat crops, as we shall show in a future chapter. On digging up some old turnips in the garden in the

* In the *Transactions of the Entomological Society*, it is stated that the *Aleochara* themselves feed upon the *Acari*. See vol. iii. p. 111.

† Curtis's *Guide*, Gen. 221; and *British Ent.*, *Homalota* and *Phytosus*, Plate and fol. 514 and 718.

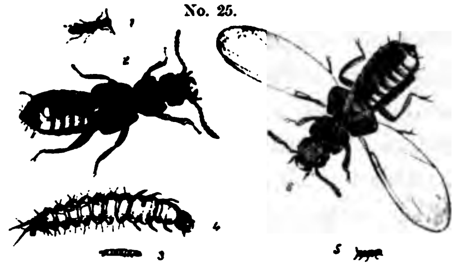
‡ Curtis's *Guide*, Gen. 216.

§ Kirby and Spence's *Introd. to Ent.*, 1st edition, vol. i. p. 186, and 7th edition, p. 104.

‖ *Gardener's Magazine*, vol. viii. p. 323.

end of March, 1842, I found several of the larvæ (No. 25, fig. 3; 4, magnified) in the rotten bulbs, with eight or ten specimens of a small rove-beetle, which I doubt not had been bred from them. The horns of the larvæ appear furcated at the second joint, from the bristle being incrassated, and, I believe, jointed: the jaws are strong, curved, and acute; there are five minute eyes on each side of the head, which is reddish brown, with a semi-circular line of the same colour on the first thoracic segment. The body is white, shaded with ochre, the intestines shining through the back behind: at the tail is a thickish foot, and above it two-jointed tapering tails, all ochreous: the six pectoral legs are of the same colour: length, 2 lines. The beetles of which these are the larvæ are COLEOPTEROUS, of the family STAPHYLINIDÆ, and this group forms the genus OXYTELUS of Gravenhorst; the species is named by the same author—

No. 25.



8. *O. sculpturatus*, the Sculptured Rove-beetle, from the deep channels upon the thorax.—It is depressed, pitchy black, and shining, excessively, thickly, and minutely punctured, and striated, with large points scattered over the surface: horns remote, short, hairy, thickened considerably at the extremity, eleven-jointed, basal joint long, forming an angle with the second, which is small and pear-shaped; third and fourth minute globose, the remainder broader than long, being somewhat cup-shaped, excepting the terminal joint, which is the largest and ovate-conic; mouth brown; jaws strong, arcuated, pointed, with a tooth on the inside, chestnut coloured; feelers visible, maxillary four-jointed, labial three-jointed, the terminal joint slender and often ferruginous: head frequently as broad as the thorax, transverse-ovate, flattened between the eyes, with an elevated ridge near each, and two short channels on the nose, with an obscure one at the base: thorax transverse, the lateral margins smooth, three broad channels down the back, the central one deepest; scutel invisible; elytra nearly quadrate, often pitchy or brown, and rarely testaceous; wings very ample, transparent, and folded under the wing-cases in repose: body very glossy, rather short, linear, the sides margined, apex pointed; six legs, short and ochreous; the thighs stoutish; shanks spiny outside: the first pair notched externally at the apex; feet rather long, slender, and tri-articulate; basal joints minute, third long and clavate; claws long, slender, and acute: length from $1\frac{1}{3}$ to $1\frac{3}{4}$ line; expanse of wings from $\frac{1}{4}$ inch to 4 lines (fig. 5; 6, flying and magnified). This beetle is similar to *O. rugosus* (fig. 1; 2, magnified): but it is smaller.

It is impossible to turn over any dung which has been dropped only a few hours without finding it taken possession of by insects, and amongst them the *O. sculpturatus* and *O. rugosus** will generally be recognized: when such deposits are a few days old they often swarm with these and other Coleoptera. They are able to fly well; and towards sunset multitudes are roving about, and apparently enjoying, on the wing, the decline of day. Indeed they may be said to be found everywhere, and at all seasons. They are able to emit an acid, or some acrid liquor, from the mouth when irritated, which causes great pain when they fly into our eyes; and it lasts until the poison becomes diluted by tears from the lachrymal ducts.

Lastly, we come to several two-winged flies, which, by depositing their eggs either in the crown of the turnip or close to the young bulb, cause the destruction of that plant. My attention was first called to this enemy of the farmer, several years since, by Edward Bennet, Esq., of Rougham Old Hall, in Suffolk. We found many of the turnip plants in that parish which had a maggot either in the young crown or just inside, at the base of the tap-root, which was indicated by a yellow tint on the leaves, the flagging of the plants in the heat of the day, and their dropping off: this was during the first week of August; in a few days after the maggots changed to pupæ, and in about three weeks two male flies and one female hatched from them. The Rev. C. Clarke also showed me some white maggots at the roots of the cabbages about the same period, which destroyed his plants earlier in the year, by eating off the fibrous roots and excoriating the stem below the surface. When I saw them they were living under the rind of the stem; and he informed me that the same or a similar maggot sometimes does great mischief to the Swedish turnips. These maggots were identical with broods reared from cabbages by another friend in Surrey; but in that instance the maggots were feeding in the beginning of June, and the flies emerged in the end of the same month.

These maggots are somewhat like those of the flesh-fly, but smaller: they are yellowish-white and shining, composed of eleven visible rings, tapering very much to the head, which is pointed, and terminated by two black horny claws, and there is a dark spot on the first segment: the rump is the thickest, and cut off abruptly, with two brown tubercles in the centre, and several short teeth on the lower margin: when full-grown they are about 4 lines long (No. 26, fig. 1);† they then change below the surface of the earth to reddish brown pupæ (fig. 2; 3, magnified): these are cylindrical and ellipti-

* Numbers of this species were discovered in the clubbed roots of brocoli, in the middle of September, in a garden in Surrey.

† Figures 6 to 9 represent the larva and fly of *Anthomyia tuberosa*. See Chap. xv.

cal, with a few black tubercles on the head, and short spines on the rump, similar to those on the maggots; for these brown cases are, in fact, their indurated skins, which are not cast off in the penultimate transformation, as they are in the caterpillars of butterflies and many other larvæ; neither do maggots change their skins as they grow, which is unnecessary, as they are extremely thin, and stretch so readily, that as the animal increases in bulk so does its skin expand. In three weeks at the utmost the flies hatch and crawl out of the earth, with their little wings crumpled up, and climbing up the side of a clod or any perpendicular surface before they get dry, they expand and become the proper organs of flight. These, as well as the following species of flies, are comprehended in the order DIPTERA, and form the family MUSCIDÆ: the genus comprising them is called ANTHOMYIA by Meigen,* and the species, from its attacking the cabbages, is named by Bouché †—

9. *A. brassicæ*, the Cabbage-fly.—The sexes of this fly differ materially in aspect: the *male* is ashy gray, very bristly; the large compound eyes nearly meet on the crown of the head, which is hemispherical: there are three minute eyes at the base of the crown; the face is silvery gray, almost white in some lights, with a long black streak on the forehead, pointed behind, below which are the black and tri-articulate horns, the basal joint of which is small, the second large, the third the largest and oval, with a bi-articulate pubescent bristle on the back, the basal joint being very minute: thorax oblong, the sides whitish, with three faint interrupted stripes down the back; body shining gray, rather small and elliptical, tapering to the apex, with a black stripe down the back; the edges of the segments and the region of the scutel black also: two wings incumbent in repose, ample, transparent, iridescent, the longitudinal nervures reaching the posterior margin, with two transverse ones towards the disk; balancers ochreous; six legs black and spiny; thighs and shanks simple; feet five-jointed, terminated by two little claws, and two largish pale leathery lobes. The *female* is of a uniform ashy gray, excepting the silvery white face and pale sides of the thorax: the eyes are remote, with a broad black stripe between them, shading into chestnut colour in front: the abdomen is stouter, and conical at the apex, and the wings have an ochreous tinge at the base;‡ length nearly ¼ inch; expanse of wings almost ½ inch.

These flies are on the wing the whole of summer, and there are consequently several generations of the maggots which are for many months

* Curtis's *Guide*, Gen. 1287. † *Naturg. der Garten-Insecten*, p. 131.

‡ For the structure of the mouth, dissections, &c., consult Curtis's *British Entomology*, Plate and fol. 768, *Hydrotæa*, an allied genus.

eating passages in the stalks and roots of the cabbage and turnip tribes, thus causing them to become rotten as soon as they are subjected to wet and frost. Many of the flies no doubt live through the winter, secreted in holes and crevices, and some of the pupæ do not hatch until the spring: in one instance the maggots and pupæ were taken from the roots at the same time, the 19th of June, and the flies began to hatch on the 27th. On pulling up the stalks of some cabbages recently cut, I found the roots enlarged, lumpy, and carious; and on opening them they were hollow, with the maggots of the cabbage-fly full-grown in cavities, several of which hatched in May, 1841, together with another fly.*

Two other species of similar flies are noticed by Bouché as attacking these crops: one he calls after Meigen—

10. *Anthomyia gnava*—Horns pubescent; eyes not hairy; legs black. *Male* with a black thorax; body linear, cinereous, fasciated with testaceous and black dorsal spots. *Female* cinereous; body with a blackish dorsal line, dilated at the base; length, 3 lines.†

The larvæ of this fly are found on the Continent during the autumn in turnips, eating cavities in the bulbs; but they have not yet been observed in England. The other species described in Bouché's work is likewise unknown to me; but as it will, in all probability, soon be detected in this country, I will give a short description of the insect, which bears the name of—

11. *Anthomyia trimaculata.*—It is like *A. carnaria* of Meigen, but smaller. The *male* is light gray, varying with the light to white; thorax with four black interrupted dorsal stripes; scutel with three brown spots; legs black; abdomen checkered with brown, and a broad black dorsal stripe. The *female* is altogether paler, with the apex of the thighs and tibiæ reddish brown: length, 3½ lines. The maggots of this are similar to the others, and they are 5 lines long; the pupa also is scarcely to be distinguished from them: it is 3 lines long.

The maggots are found in summer and autumn in company with *A. brassicæ*, in cabbage-roots, which they destroy. They remain pupæ three or four weeks, and the latter generations winter in the earth under that form, and produce flies in the spring: the female flies are tolerably abundant in fields and gardens.

The last species I have to record was sent to me from Northumberland by Mr. T. H. Scott, the 21st July, 1841. He says, "My servant, who has

* *Eumerus æneus.* See *Gardeners' Chronicle*, vol. ii. p. 252; and Curtis's *British Entomology*, Plate and fol. 749.

† Meigen's *Syst. Beschr.*, vol. v. p. 164, No. 142.

been hoeing the turnips, tells me these larvæ are always found *in* the roots, and not in the surrounding soil. Since the late rains they have decreased, and it was with some difficulty the few I transmit could be found in two acres." They were taken out of the roots, several of which were sent to show the mischief done by the maggots and the little rove-beetles: precisely at the same period of the year, on cutting a turnip in halves from the garden, I found a maggot inside quite as large as Mr. Scott's.

The above maggots were similar in form to those of *A. brassicæ*, but of a yellowish ochre colour. The head was armed with two black hooks; and at the extremity of the back was a green stripe, from the intestines shining through; the rump was truncated, and furnished with two brown projecting spiracles, and the margin surrounded with small teeth, largest below. I put them, with a turnip-root, into a flower-pot, and the following April I found four of them in the pupa state, and buried deep in the earth; these pupæ were also like those of *A. brassicæ*, but of a paler colour, being lurid ochreous. On the 25th April I bred a male fly, and soon after two females; they proved to be a Linnæan species of *Musca*, the larvæ of which will devour a great variety of roots, and inhabit dung by thousands in the summer, according to Bouché; the fly is called—

12. *Anthomyia radicum*, the Root-eating Fly. It is similar in size and form to *A. brassicæ;* but the *male* (fig. 4; 5, natural dimensions) has an ochreous face, reflecting satiny white; the stripe on the forehead is rusty; the thorax is black, with three darker stripes; the sides are gray; scutel blackish; abdomen slender, linear, shining gray, with a broad black dorsal stripe; the incisures are black also; wings, balancers, and legs as in *A. brassicæ*. *Female* still more like that species; but there are three fuscous stripes on the thorax, and in certain lights a slender dark line down the back of the abdomen: length, 2½ lines.

No. 26.

It is remarked by Bouché that the larva of a four-winged fly called *Alysia manducator* lives in the pupæ of several flies allied to those above described; it makes a thin yellow case inside of the pupa, and comes forth in spring and summer, when it is not unfrequently seen in and about decayed turnip-roots and dead animals, in a state of decomposition. From these observations it may be inferred that it is a general parasite of such flies, and that those maggots which infest the turnips and cabbages do not escape its vigilance. I will therefore add a short description of this useful insect. It is HYMENOPTEROUS, of the family ICHNEUMONIDES ADSCITI; and is called by Panzer—

13. *Alysia manducator*, from its gaping teeth or jaws.—It is black, and very shining; the tridentate jaws are chestnut; antennæ rather long, slender, pubescent, composed of numerous joints; postscutel and broad flat base of abdomen rugose, the latter oval, with a projecting ovipositor in the female; four wings with the stigma and nervures pitchy; legs bright rust colour; feet dusky: length, ¼ inch; expanse, ½ inch.*

With this exception I know of no parasitic insects to keep these turnip-destroying maggots in check; I shall therefore now conclude this investigation of their habits and economy by appending such remedies as have fallen in my way. It often happens that very good specifics which may be successfully employed in the garden cannot conveniently be extended to the field; such, I fear, is the following remedy proposed by Bouché. He says that where whole fields of cabbages have fallen a sacrifice to the destructive maggots, that the crops are now completely preserved by dipping the roots, as they are transplanted, into oil or ley of ashes. One of the best modes of diminishing their numbers, I doubt not, is to pull up and remove infected plants on the first symptoms of the presence of insects at their roots, which is instantly detected by the drooping of the leaves in the sunshine, those of the cabbages turning of a faint lead colour, and the turnip-tops becoming yellow. When this is the case, they should be immediately carried away and burned, and brine or ley of ashes may be at once poured into the holes from whence the plants have been drawn, to destroy any insects left behind. In other instances, where the maggots have made great havoc with the cabbages, cauliflowers, and broccoli, gardeners have collected large quantities of the brown pupæ from the roots with the hope of checking their increase; and as the transformations of the insects are in rapid succession, it must have a good effect, by giving the succeeding crops a better chance of escaping the fate of those which preceded them.

Mr. Sinclair, in allusion to the turnip-galls, says, "Combinations of salt and lime were evidently the most effectual, as no instance occurred of the bulb being affected below the surface of the soil. That portion, however, of it which was above the surface was affected with galls, the same as in the bulbs grown on soils of the same nature, to which no application of manure had been applied. On a space of the same soil, to which salt simply had

* Curtis's *British Entomology*, fol. and Plate 141; and *Guide*, Gen. 558, No. 5.

been applied the preceding spring, and from which time the soil remained fallow, the crop was good. One plant in ten, however, was affected with the disease below the surface, as well as above it. The salt in this instance had been applied at the rate of 86 bushels per acre, and mixed with the surface 4 inches deep; it was applied the first week of May, 1818. On one portion of it barley and turnips were sown, but they did not vegetate, the dose being too great. The season following, however, the crop was good." It was observed that the same dressing on a clayey loam did not prevent the galls from forming. I apprehend, however, that the lime and salt would certainly destroy the different maggots that we have described, but not the weevils; for it must be remembered that the author of the galls is a hard beetle, and its embryo young live under the rind, secure at that period from any outward applications. Mr. Sinclair goes on to say that "mixing the lime and salt with the soil previously to sowing the seed, or applying it to the surface after sowing, proved best; for when lime and salt are mixed and deposited with the seed, vegetation is retarded from two to twelve days, and more, beyond the natural period. This fact was proved on the seed of eight different species of plants, sown in four different kinds of soil. They modify, but are not a specific remedy for this disease. Seeds from roots perfectly free, sown on land that never was sown with turnip-seed before, produced in both instances bulbs more or less affected."*

Another contributor to the *Gardener's Magazine* says, the attacks of insects causing the malformations in turnips can only be averted by making the plants offensive to the parent fly; and this, it has been lately discovered, can be done by incorporating with the soil soap-boilers' waste, or any other substance of similar alkaline quality. Mr. Major recommends the plants to be watered with a mixture of 1 gallon of soap-suds to 4 quarts of gas-water, or, in lieu of the latter, 2 quarts of gas-tar; either will do, as the only use of the mixture is to create an offensive smell. Mr. T. Smith says he is satisfied, from six years' experience, that the refuse of a charcoal pit, spread ½ inch thick before sowing the seed, and merely scuffled in with the point of a spade, so as to mix the top soil and charcoal dust together, is a remedy for the grub and mouldiness in onions;† and it effectually prevents the clubbing in the roots of cabbages and cauliflowers.

Few of these remedies will, I fear, be of much service on a large scale; the farmer must therefore encourage the natural enemies of these pests, and

* *Memoirs of Caledonian Horticultural Society.*

† *Anthomyia ceparum* (*Gardeners' Chronicle*, vol. i. p. 396): the maggots of this fly are so similar in appearance and economy to those of the turnip, that many gardeners take them to be the same species.—See Major's *Treatise on Insects*, p. 165.

remember that rooks, sea-gulls, magpies, and partridges, as well as many species of small birds, are eminently useful in cleansing the soil from such troublesome insects. If poultry be turned into the field they require attention, otherwise they are apt to scratch up the soil. My own opinion is, that nothing can be more likely to encourage the maggots of the cabbage and turnip-flies* than fresh dung, in which it seems they luxuriate; and, such being the case, by spreading it in a raw state, an entire field may at once be inoculated with the disease.

SUMMARY OF THE FOREGOING CHAPTER.

Surface-grubs, in 1818, 1826, 1827, and 1836, were very numerous and destructive to turnip crops; so much so, that prizes were offered for the history of these caterpillars, and the remedies for their destruction.

The *cabbage-moth* flies by night in May, June, and July: the female lays her eggs upon the leaves of cabbages, turnips, &c.

The *caterpillars* are *universal feeders*, living upon an astonishing variety of plants, during July, August, September, and October: the garden suffers most from their attacks, and cabbages have their hearts quite riddled and defiled by them.

They sometimes *live through mild winters*, concealed either amongst rubbish on the surface or buried in the *earth*, where they change to *chrysalides*.

The most effectual *remedy* is to *search* for them *at night*, when they come out to feed, and to look carefully *beneath the leaves by day*.

The *great yellow under-wing moth* is abundant in hay fields, hedges, and gardens, in June and July: it is the parent of a large *surface-grub*, which feeds upon the *roots and leaves of turnips* in the autumn: it lives through the winter, sometimes under the turf in meadows, &c., and can resist frost. In April it changes to a large brown *chrysalis*, in the soil, inclosed in an earthen case.

In a bed of *onions*, which this caterpillar had *destroyed*, forty-seven were found in an area of less than 25 feet.

The *heart-and-dart moth* is found plentifully in June, in fields, gardens, &c.: it is the parent of a most pernicious surface-grub, which destroys immense quantities of turnips, at every stage, either by separating the crown from the root, or by eating into the more matured bulb.

* We have on a former occasion animadverted upon the impropriety of calling the *Altica nemorum* by the name of "turnip-*fly*;" which is here exemplified, for the above insect is truly the turnip-*fly*; and the *A. nemorum*, the turnip-flea or black jack, is as undoubtedly a *beetle*.

The *surface-caterpillar* attacked the *Swedes* in August: it was abundant in November, and no doubt lived through the winter.

The *common dart-moth* flies in multitudes in June and July, and is supposed to lay its eggs in the earth, which produce surface-caterpillars more destructive, if possible, than any of the others.

The *eggs* hatch in autumn, and the surface-grubs live through the winter: they are either feeding a long period, or there are two broods annually.

Mangel-wurzel had the young roots eaten through by them in June: they also attacked the potato-shoots.

Abundant in August, 1841, at the *roots of Swedes*, in Surrey; and in multitudes at Farnham, in September, 1839. During the same months they abounded in Suffolk, in 1835, and were numerous there in November, 1841.

The western countries of Europe have been threatened with *famine* from their destroying the *corn*, by devouring the roots, especially of that sown in autumn.

The gardener suffers from their attacks, for they will feed upon the *roots* of various *vegetables* and *flowers*.

As they are forced to feed upon the *roots of grass and weeds*, in the summer, in fields lying fallow or recently sown, it is most essential to keep the land clean whilst at rest.

They pass the *winter* under-ground, in earthen cells, and come forth to feed again in the early *spring*.

In May or June they enter the earth to change to *chrysalides*, in which they remain about a month.

Mr. Le Keux found these surface-grubs concealed, by day, in *burrows* 2 or 3 inches deep, into which they draw *detached leaves*.

Salt and water poured over a turnip plant, at the rate of ¼ oz. of salt to 1 quart of water, drove the surface-grub away, but it proceeded to another 6 yards off: they can travel well and expeditiously, especially at night, when the ground is damp. During ten days other plants were washed with that solution, and were thus preserved; but, when discontinued, they shared the fate of the others.

Children might readily *pick* them from the roots with a sharpened flattish stick, or an oyster-knife.

Serious attacks of these surface-caterpillars are often to be attributed to the *destruction* of the *rooks*.

Another, and larger *surface-caterpillar* feeds upon *turnip roots*, and eats off the *crowns*: these larvæ also injure the roots of *cabbages*, and will devour the *leaves*. They bury themselves very deep; and are 2 inches long in the autumn: they were in the chrysalis state in March.

The *surface-grubs* are at work almost all the year: in the *summer* they destroy the young plants by eating off the roots near the crown; in the *autumn* and mild *winters* they eat large cavities in the bulb, which get filled with dirt, and are not good for stock; the *weight* is also *reduced*, and they more readily *decay* from wet and frost.

Harrowing, ploughing, and working the soil, afford the only chance of destroying the *eggs*, and probably the *chrysalides*.

Insects thrive best on *neglected* and slovenly cultivated *lands*.

Night-time is the best for applying *liquids* and *powders* to destroy the surface-caterpillars.

Tobacco-water will kill them, if it come in *contact* with their *skins*.

Hand-picking by night is universally recommended on the Continent.

Dry soot, spread 1 inch thick, and dug in, is said never to fail. *Cabbage* plants may be preserved by laying some round the stems.

Lime also, employed in the same way, is a protection; and if *quicklime* were dusted over the turnips, after rain in the evening, it would destroy the surface-grubs.

Poultry and *ducks* would be serviceable, if turned into the field when *ploughing*.

In *gardens*, planting *cabbages*, &c., round a seed-bed is a good *decoy:* the roots may be daily searched, and the larvæ destroyed.

When a *plant dies*, dig it up immediately, and the larvæ will be found.

Soap and water poured round the plants will compel the surface-grubs to come out of their burrows, when they must be directly picked up.

Pigs, perhaps, may be employed late in the year, where the surface-grubs are swarming, and ten or twelve round one bulb.

No *outward applications* will affect the *chrysalides*, which lie entombed in the earth.

Fires at night, to attract the moths, of little service, as the *females* are not caught by such means.

As regards *corn-crops*, *late sowing* would prove the best; and June and July the most improper for *turnips*, where the surface-caterpillars are numerous.

Spring-corn most likely to suffer from their attacks.

Soils made *strong and warm* by horse-dung manure most infested, from the *eggs* hatching more rapidly.

Steeping the *seeds* in bitter extracts mixed with salt or nitrates useless; but *ammonia* would annoy the surface-grubs, if applied in sufficient quantity to the soil; and liquid manure would therefore be beneficial.

Slaked lime mixed with seed-wheat, and then heated and sown together, has been recommended.

Scattering ashes before and after sowing might secure the crops.

Sticking inverted young *fir trees* in the fields protects crops, it is said, in Sweden, from seed-eating caterpillars.

Hemp, sown round a field, will attract small birds, which will also feed upon the insects.

No parasitic insects hitherto detected to check the increase of the surface caterpillars.

Directions for rearing surface-caterpillars, and breeding the moths from them.

The *turnip-gall weevil* is produced from the excrescences on turnip-bulbs.

These *galls* contain from one to four *maggots*, which feed upon the *bulb;* the galls are probably caused by some fluid from the parent beetle.

These *galls* are formed in *summer*, and increase through the *winter*.

The *maggots* most probably change to *pupæ* in the earth.

The *turnip-gall beetles* are not uncommon in hedges, &c., in spring and summer.

Partridges pick out these maggots, and are very fond of them.

Anbury, I think, is not caused by insects; but the disease affords a suitable pabulum for many species.

Anbury and *fingers-and-toes* two distinct diseases? the former with knotted roots, the latter more forked.

Mr. Dickson's observations on *fingers-and-toes.*

Mr. Marshall's description of *anbury;* he considers it caused by the puncture of an insect.

A *naked fallow* recommended as a remedy.

Marl or *chalk* the most certain and lasting cure.

Teathing the barley-stubble will cause anbury.

Whether *wet or dry seasons* are most favourable to anbury seems to be doubtful.

The *long pudding-turnip* the most, the *Swedes* and *rounds* the least diseased.

In the tap-root, *maggots*, *mites*, *rove-beetles*, &c., were living.

The *knots* on the roots *solid*, and in no instance containing insects.

Certain conditions of the *soil*, and *not insects*, cause anbury.

The *maggots* inhabiting the anbury lived through part of the winter, and produced the "*Winter Turnip-gnat*" very early in the spring.

The *mites* may feed upon the larvæ or the eggs of the flies, &c., deposited in the anbury, or they might have been introduced by the larger beetles which they infest.

Rove-beetles, called *Aleochara* and *Oxytelus*, inhabit decaying turnips in multitudes.

They are supposed to *nibble* and injure the *roots* of the young *turnips*, and they will also feed upon *maggots:* their own larvæ are found with them.

The *Oxyteli* are found everywhere, and inhabit *dung* in immense quantities.

Maggots found in August, and earlier, *in the crown*, or just in the base of the tap-root, which do great mischief.

They change to *pupæ* in the *earth*, and in three weeks they produce flies, called the *cabbage-fly*, which live through the summer.

Two species, of similar habits, are known upon the *Continent;* and a fourth I bred from other *maggots*, which had injured the young *turnip-roots*.

They are *exceedingly mischievous*, as they will feed upon a great variety of *roots;* and inhabit *dung* in thousands.

They changed to a fly, called the *root-eating fly*.

A very useful *parasitic fly* lives upon these *maggots*.

Dipping the roots in oil or *ley of ashes* will preserve cabbages from the maggots.

As soon as *plants droop*, pull them up and burn them; and then pour brine or ley of ashes into the holes, and it will kill all that remain.

The *pupæ* may be collected from the roots, in gardens at least, with great advantage.

A *dressing of lime and salt* would kill the maggots, but it will not prevent turnip-galls from appearing.

The *lime and salt* should be mixed with the soil previously to sowing the seed, as they otherwise retard vegetation.

Soap-boilers' waste, and other alkalies, incorporated with the soil, will kill the maggots.

Soap-suds and *gas water*, or *gas-tar*, will keep the flies from depositing eggs.

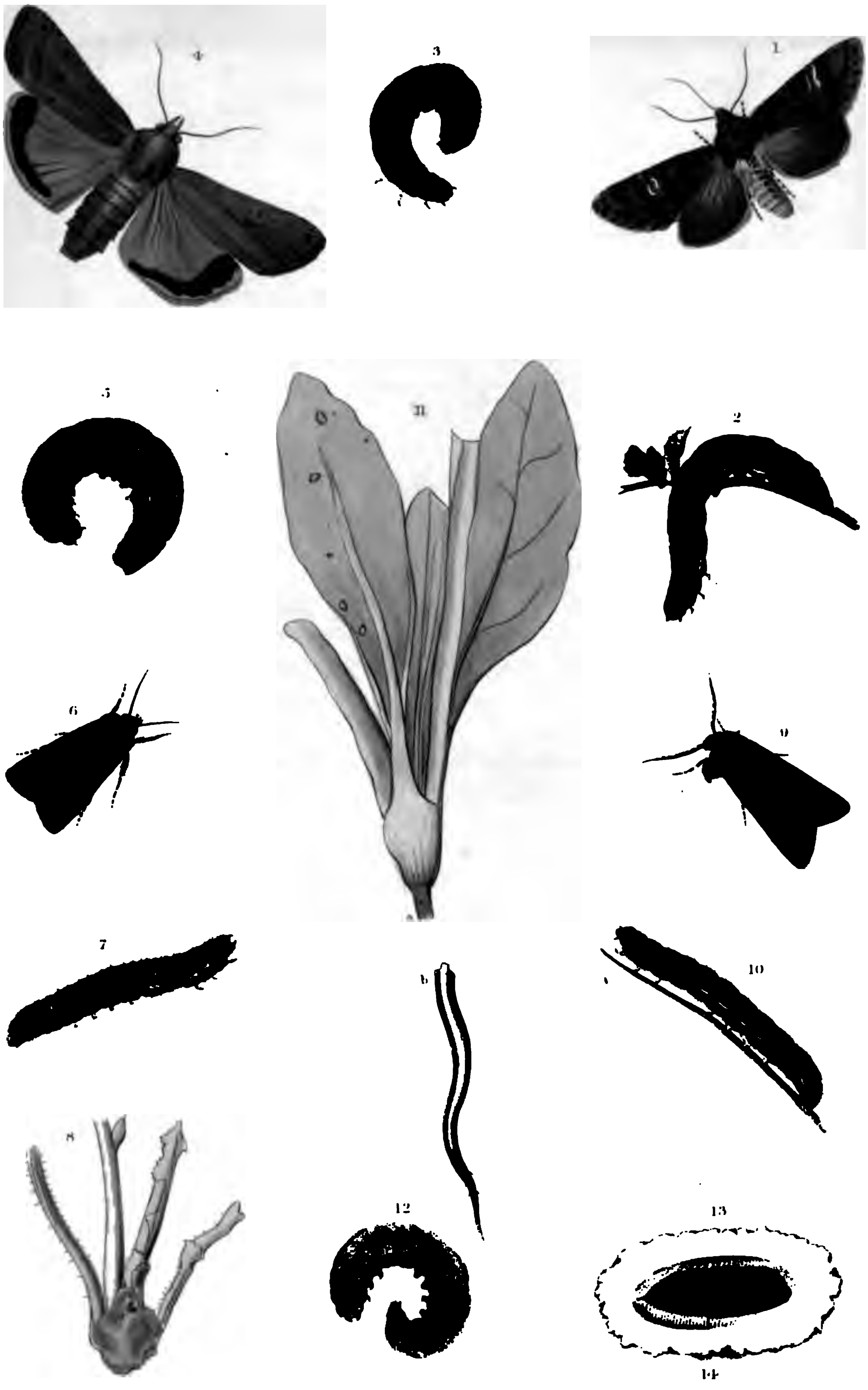
Refuse of *charcoal*, scuffled into the soil, prevented the same disease in *onions*, and the clubbing of *cabbages*, &c.

Rooks, sea-gulls, magpies, partridges, &c., most useful in securing crops from the attacks of insects.

Raw dung, especially horse-dung, encourages the maggots, and should therefore never be spread in that state, not even in small quantities.

TURNIP AND MANGEL-WURZEL CROPS

Surface grubs or caterpillars with their Moths living on Turnip and Mangel Wurzel roots.



EXPLANATION OF PLATE E.

Fig. 1. *Noctua brassicæ*, the cabbage-moth.
Fig. 2. Caterpillar of the same.
Fig. 3. Ditto, a green variety.
Fig. 4. *Noctua pronuba*, the great yellow underwing moth.
Fig. 5. Caterpillar of ditto.
Fig. 6. *Noctua exclamationis*, the heart-and-dart moth at rest.
Fig. 7. Caterpillar of ditto.
Fig. 8. A turnip-crown with the root eaten off.
Fig. 9. *Noctua segetum*, the common dart-moth at rest.
Fig. 10. Caterpillar of ditto.
Fig. 11. A young mangel-wurzel plant with the root eaten through by the last surface-caterpillar.
a, The base of the root.
b. The terminal portion.
Fig. 12. A caterpillar, or surface-grub: the moth it would change to not ascertained.
Fig. 13. The case of earth which the surface-grub forms in the ground.
Fig. 14. The chrysalis contained in it.

All the figures are drawn from nature, excepting No. 2.

CHAPTER VI.

THE NATURAL HISTORY AND ECONOMY OF THE INSECTS CALLED WIREWORMS, AFFECTING THE TURNIPS, CORN CROPS, ETC.; ALSO OF THEIR PARENTS THE ELATERS OR BEETLES, CALLED SKIP-JACKS, CLICK-BEETLES, ETC.

It is an incontrovertible axiom—"That the profit we derive from the works of creation will be in proportion to the accuracy of our knowledge of them and their properties."—Kirby and Spence's *Introduction to Entomology*.

As wireworms not only injure the turnip but various other crops, I shall terminate my account of the insects affecting that plant by detailing the history of the animals thus designated, making them the transition to the corn crops, which are subject to the attacks of other insects, whose economy will be found equally interesting and important to the agriculturist.

Of all the insect enemies with which the farmer has to contend, there are none which are more fatal in their effects, and more difficult to overcome, than the wireworms. It has already been stated that the larvæ of many insects are not unfrequently attached to one species of plants, or at least to one particular tribe or "natural order;" thus the ravages of the turnip-fly or beetle,* are confined to the Cruciferæ,† of the black-caterpillar‡ to the turnip, of the Hessian-fly to corn, &c.; but in the wireworm we have an example of a larva which may almost be termed omnivorous, as far as regards the productions of the field and garden, for it will feed upon corn, turnips, mangel-wurzel, potatoes, grass, and cabbages, as well as upon the roots and stems of the choicest flowers; its operations, therefore, being so unlimited, the mischief done by these formidable little animals must be incalculable.

It is true that every grub and worm§ found at the roots of their crops by the farmer and gardener has been hitherto stigmatized with the appellation of "the Wireworm," which has no doubt contributed to aggravate the amount of mischief complained of; nevertheless, the true wireworms have enough to

* See Chapter i. † So called from the four leaves or petals of the flowers forming a cross.

‡ See Chapter ii.

§ Millipedes, Centipedes, and the larvæ or maggots of Gnats and Tipulæ have been thus confounded.

answer for on their own account, and the great ignorance that has existed regarding them renders a narrative of their natural history very desirable. An instance, which occurs in the *Gardener's Magazine*,* will be sufficient to substantiate the assertion; figs. 93, *b* and *c*, are there given as the larva and pupa of *Elater segetis*† (viz., the *true* wireworm), but they are undoubtedly the offspring or produce of some insect not belonging to the same order, but probably to the *Diptera* or two-winged flies. Such errors are sadly mischievous in a work expressly intended to convey information to all classes, and no subsequent correction can entirely eradicate a blunder and its effects when once circulated by the press

It will probably surprise the general reader to learn that there are nearly seventy species of beetles in this country which are the parents of wireworms; many of them, however, live in decaying trees or under the bark, and the number of species that affects our crops of corn, vegetables, and flowers, is very limited; of these we shall treat as far as we have been able to obtain data for their histories; but their economy appears to be so similar, that it will be most convenient to consider them in the first instance as "the wireworms."

Of the species of beetles producing these larvæ (for such the wireworms are), there are not more than eleven I believe that will require our attention; they belong to the order COLEOPTERA, they form the family ELATERIDÆ and the genus ELATER of Linnæus, which has since been divided into several others by modern naturalists. These beetles have been called elaters from a peculiar power they have of leaping up like a tumbler when placed on their backs, and for this reason they have received the English appellations of "Spring-beetles" and "Skip-jacks," and from the noise which the apparatus makes when they leap they are also called "Snap" or "Click-beetles," and likewise "Blacksmiths." The species we will enumerate and describe hereafter, and detail at present their economy: after pairing, the female beetle lays her eggs; the eggs produce little larvæ called wireworms, which grow and change to pupæ or chrysalides, and from these again emerge the beetles.

Whether the eggs (Plate F, fig. 1), which are nearly globose or slightly oval, yellowish white, and very minute,‡ are laid in the earth close to the root of a plant, or between the enveloping leaves or sheaths near the base of the stalk, I am unable to determine; it is a very desirable part of their economy to be ascertained, but hitherto I have endeavoured in vain to detect a female depositing her eggs, or to find any, except by dissection, when I have

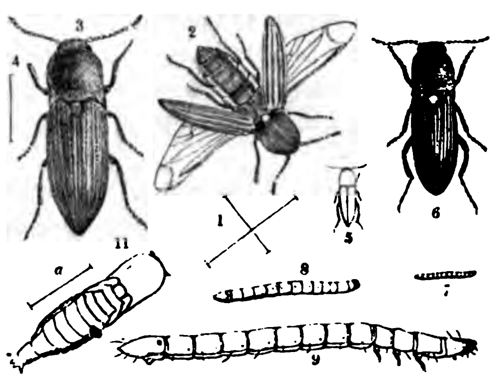
* Vol. vi. p. 500.

† This name is synonymous with *E. lineatus*, as will be shown a few pages farther on.

‡ Those of *E. pectinicornis* are oval, whitish, and shining. De Geer's *Hist. des Ins.*, vol. iv. p. 143.

observed them close to the base of the oviduct; the little worms produced from these eggs must be almost invisible to the naked eye; they grow very slowly, and eventually attain the length of ¾ inch, rarely 11 lines.* These are the true wireworms (Plate F, fig. 2, and No. 27; fig. 7, larva of *A. sputator?* and fig. 8, the larva of *A. lineatus*, magnified at 9), so named from their semi-cylindrical form, smooth surface, and extreme toughness. In this state they live five years, as proved by Bierkander,† casting off their skins thrice, probably, like other larvæ, as they increase in stature. I have examined many of these exuviæ, which are brown; and the animals perform this extraordinary moult like other caterpillars, by splitting the horny skin along the thorax, and drawing themselves out at the aperture, leaving (like a snake) a perfect exuvia of every part, including eyes, horns, feet, and it is believed also of the internal organs.‡ Immediately after this operation, the wireworms are very tender, and of a whitish colour; but as soon as they recover from this great effort of nature, they move about with the greatest facility, gliding along and soon burrowing into the earth when dug up and laid on the surface, their smooth horny coats being well adapted to their subterranean habits.

No. 27.



The wireworm very much resembles the mealworm;§ it is of a pale ochreous colour, becoming darker when dead, with a few hairs scattered over its polished shining skin; it is semi-cylindrical, the back being convex, the belly more flat; its head is flattened or wedge-shaped, and there are twelve abdominal segments; the mouth is rather small, and comprises an *upper lip* (fig. 3) with a horny base, the margin leathery and bilobed; it is small, and concealed beneath the *clypeus* (fig. 4), which is rigid, with a ciliated lobe on each side, and three minute teeth in the middle; beneath is a large semi-ovate space (fig. 5) formed by the union of the base of the maxillæ (*b*) with the *mentum* or chin (*c*), which is long and narrow; the *under lip* (*d*) is small

* There are twelve lines in an inch.

† *Commun. to Board of Agri.*, vol. iv. p. 413; and *Trans. Acad. Scien. in Sweden*, volume for 1779, p. 285.

‡ See Mr. R. J. Ashton's paper in *Transactions of the Entomological Society*, vol. iii. p. 157.

§ Curtis's *British Entomology*, fol. and Plate 331.

and somewhat obtrigonate, the base truncated, the margin undulating, and furnished with two small bi-articulate *palpi* or feelers (*e*), sometimes with an indistinct third joint; on either side is the *maxilla*, having a minute and densely pubescent lobe on the inner angle, with a larger bi-articulate one behind it* (*f*), and a four-jointed *palpus* or feeler on the outside, the terminal joint the smallest (*g*); above these are the *mandibles* or jaws (fig. 6) which meet over the mouth, one being placed on each side; they are strong, horny, and of a pitchy colour, being more or less pointed, with a tooth below the apex, and frequently a smaller one at the middle,† and below this is a ciliated space. There are also two little *antennæ* or horns (fig. 7), placed in front of the head near the anterior angles; they are tri-articulate, and similar to the palpi in form, the basal joint being the largest, the terminal one short and slender (*h*); sometimes there is a tubercle projecting from one of the angles of the second joint (*i*), but whether these are accidental differences or characteristic of different species is not at all clear. On each side of the head and behind the antennæ is a minute dot like a little eye. The first abdominal segment is much longer than the two following (fig. 2,* *j*), the eight succeeding have a minute spiracle on each side (fig. 2); the terminal one is the longest and conical (fig. 9), with a brown or blackish oval aperture or spiracle (?) larger than the others on each side towards the base (*k*); beneath this segment is also a false leg or prehensile foot (*l*) which assists in walking, and is probably the vent for the evacuation of the digested food; the three first or thoracic segments are furnished with six short legs, a pair being attached to each near the hinder margin; they are nearly alike and four-jointed (*m*), the joints being rough, with short brown spines, the apex furnished with a strong claw, slightly curved, and nut-brown (*n*).

When the wireworm has arrived at maturity, it descends a considerable depth into the earth, forms an oval cell there (fig. 10), entirely composed of the surrounding particles of soil, and not even lined with silk, as in the turnip saw-fly;‡ it then casts its skin again, and becomes a pupa, or chrysalis, generally, it seems, at the end of July or beginning of August; it is long and narrow in form, like the perfect insect, but it is of a yellowish white (fig. 11; and No. 27, fig. 11; *a*, the natural length); there are two minute spines projecting from the anterior angles of the thorax; all the oral organs

* These are the analogues or parts which correspond with the two hairy lobes in the beetles (see fig. 24).

† These jaws are sometimes so worn at an advanced age, that the apex is rounded and the smaller teeth have entirely disappeared.

‡ See Chapter ii. Plate B, fig. 3.

are visible, the horns and legs are folded or incumbent upon the breast, and the wing-cases, as well as the wings, are small, and the least developed of any part (fig. 11*); the scutel and abdominal segments are distinct, the apex being furnished with two moveable spines and two lobes terminated by nipples in the middle beneath. Of course at this period the animal is at rest, being deprived of the power of locomotion, and is consequently no longer injurious. Several were found in this state on the 26th of July, 1841, and Bierkander says, that in the month of July his wireworms became pupæ, from which the elaters emerged in their perfect state about the 10th of August; it has also been elsewhere recorded, that they remain in the pupa state two or three weeks, but many no doubt pass the winter buried and protected from casualties and the rigour of that inclement season; when, however, the appointed time comes, they burst from their shrouds and the earthy tombs they inhabit, and rising through the soil, arrive at the surface changed to perfect beetles, but of a whitish colour, soft, and extremely tender; exposed to the air and light, their bodies harden and their colour gradually changes, so that in a few hours they have attained the horny coat which covers them, and assumed the tints which the Author of nature has assigned to the species.

The parts of the animal which were lately indistinctly seen, as through a veil, are now distinctly visible, and all the members are liberated to give action to its body and animation to all its senses. They walk and run like dogs, with their heads and trunks declining, their noses close to the ground; when they leap, their legs are applied closely to their bodies, and by the same means they fall down when the plants are approached upon which they are resting. These elaters (figs. 12 and 25) have small heads and eyes, the latter minute, hemispherical, and reticulated, a portion being frequently concealed beneath the margin of the thorax; the two horns, or *antennæ*, are generally slender and eleven-jointed (fig. 13), and received, when at rest, into two grooves beneath the *thorax* (fig. 19, *o*), which is more or less oval-quadrate, the hinder angles produced and forming spines; the wing-cases or *elytra* are long and narrow, covering a pair of ample *wings*, which are closed longitudinally like a fan, with the tips folded over when in repose. They have also six *legs* for walking; the anterior pair is a little the shortest, and the hinder the longest (fig. 14); the thighs are stout; the tibiæ or shanks simple; the tarsi or feet are as long, and all five-jointed, the basal joint the longest, except in the anterior pair, and the last is furnished with two curved acute claws. In this state its habits are quite altered; instead of the ravenous and destructive wireworm, it is now become an active beetle (figs. 12, 25, and 26), running up the grass, and readily flying to flowers, to which it resorts for food; the sexes also pair, and the business of the male being accomplished he probably dies, but the female is longer lived; the organs of generation are frequently at this period exserted, when they may be easily examined with a magnifying glass; those of the *male* (fig. 15) are received into the apical segments of the abdomen in repose (*p*); they are ochreous and shining, formed of two valves, rounded at the apex, with two minute hairs, the central lobe being lanceolate (*q*). The *female* has a longish horny ovipositor, which is easily protruded from the extremity (fig. 16); it is flat and linear, the apex conical, thickened, and forming two lobes, each of which is produced and hairy; at the tips are two minute obovate appendages, with two hairs at the apex (*r*). In *Elater obscurus* the flattened tube is terminated by two horny lobes (fig. 17, *s*), pear-shaped when united, with two hairs outside, and having no appendages, they are capable of distension to allow the eggs to pass. In the same species the generative organs are not so long as usual in the male (fig. 18); the lateral valves are pointed and notched outside, and the central lobe is strap-shaped, the apex conical, with a minute notch on each side (*t*), and this appeared to me to be folded back upon the base in a quiescent state.

We have already alluded to the remarkable power these beetles have of recovering their natural position when they fall upon their backs; their legs not being long enough for that purpose, they are furnished with an apparatus which I will now describe. Fig. 19 is the under side of the thorax (*u*), showing the cavities in which the first pair of legs is inserted; between them arises a spine, with two small teeth at the base (*v*), and sometimes one above, towards the apex. Fig. 20 is the under side of the post pectus or breast, with two oval cavities, into which the second pair of legs is fitted (*w*); and behind are the trochanters or hips, to which the third pair of legs is attached (*x*): at the anterior margin is a long cavity (*y*), into which the spine (*v*) is pressed, and the animal, when on its back, by depressing the head and tail, raises this spine with such force, that the point is jerked out of the cavity that holds it; bringing the centre of the back suddenly upon the plane, a spring is created which raises the beetle many inches from the ground, and turning over in the air it alights on its feet; the height of the leap depending greatly upon the hardness and smoothness of the surface of the plane, and some species can bound much higher than others.

The mouth of the perfect beetle varies considerably from that of the larva or wireworm; the upper lip or *labrum* is rather large (fig. 21), and nearly concealed beneath the projecting forehead; it is transverse-oval, the anterior margin is pubescent, with a membranous edge, and it is ciliated with long hairs. The two *mandibles* or jaws (fig 22) close over the rest of the mouth, which is sometimes scarcely discoverable in repose; they are strong and horny, clawed at the apex, with a strong tooth on the inside; towards the base is a leathery oval lobe, the margin of which is densely hairy. The chin or *mentum* is transverse and narrowed in front (fig. 23), from whence arises the *labium* or under lip (*z*), which is leathery, somewhat quadrate, the anterior margin trigonate; to the centre of this is attached a pair of small *palpi* (a) of three joints, the two basal ones are small and pear-shaped, the third is larger and hatchet-shaped. On either side of the chin is attached a *maxilla* (fig. 24), which is terminated by two broadish lobes that are densely pubescent at their extremities; and on the outer edge arises a *palpus* or feeler (b), larger than the labial and four-jointed; the basal joint is small, second and third much larger and stouter, especially at the apex, the fourth joint the largest, and more or less hatchet-shaped; they are slightly hairy.

Amongst these elaters, which are the parents of the wireworms, just as the turnip saw-fly is of the black caterpillar,* there are four species which are most common in corn fields: their metamorphoses have been traced from the worm to the perfect beetle, and these we will first describe. Owing to a difference in their structure, they are not included in the same genera by modern naturalists; one group being called AGRIOTES by Eschscholtz, the other, ATHÖUS, by the same author;† but they are all elaters of Linnæus. In *Agriotes* there are three species, unless one be a variety only, which affect the crops; one is called—

1. *E. sputator*, by Linnæus, and is the smallest of them: it is shining, piceous, and clothed with very short ochreous pubescence: head and thorax black, thickly and distinctly punctured; the latter orbicular, convex, the hinder angles forming short stout teeth, sometimes rufous; down the centre is a channel: scutel subovate; elytra or wing-cases not broader than the thorax, but more than twice as long, elliptical, convex, slightly rugose, with nine punctured striæ on each: antennæ and legs rufous; the former not longer than the thorax, slender, the joints obconic, basal the stoutest, second a little longer than the third, which is the smallest; feet with five distinct joints; length from 3 to $3\frac{3}{4}$ lines, and breadth from 1 to $1\frac{1}{8}$ (No. 27, fig. 5; 6, magnified). Some specimens are entirely tawny, excepting the black eyes and tips of the mandibles; whilst others have the head and thorax only black, the hinder margin of the latter and the spines being tawny, as well as the elytra. From the great difference of colour, this elater was named *E. variabilis*, by Herbst; and Paykull, thinking it was the same as the next described species, gave it the name of *E. obscurus*. *E. sputator* is very

* See Chap. ii. Plate B, figs. 2, 6, and 7.

† Curtis's *Guide*, Gen. 309, Nos. 30, 31, and 32.

abundant everywhere from the beginning of May to the end of June, in hedges, on grass, under oaks, in corn fields, &c.; it occurs also in profusion amongst rejectamenta left by floods.

2. *E. obscurus*, Linnæus (Plate F, fig. 25; and No. 27, fig. 3; the line at 4 showing the natural length), named also *E. variabilis*, by Fabricius, and *E. obtusus*, by De Geer.—It is rather more robust than the former, and the sides of the thorax are more convex; it is piceous, densely clothed with short depressed ochreous hairs; the head and thorax are thickly and distinctly punctured; the latter is as broad as it is long, orbicular, very convex; the posterior angles are produced into strong spines, and there is a channel down the back; scutel oval; elytra not broader than the thorax, and nearly three times as long, elliptical and convex, the extremity when united conical, the apex of each rather acute, reddish brown, and punctured, each having nine punctured striæ, somewhat in pairs; antennæ a little clavate, quite as long as the thorax; basal joint stout, second and third of equal length, shorter and smaller than the following, the terminal one ovate-conic (fig. 13), reddish brown, as well as the legs; the feet, or tarsi, distinctly five-jointed; length, $4\frac{1}{4}$ lines to $4\frac{1}{2}$; breadth, $1\frac{1}{5}$ to $1\frac{2}{3}$. The pubescence is so thick on perfect specimens as to give them a dull brown tint all over; whilst others, which are old and rubbed, appear blackish. From April to midsummer this beetle is abundant in fields, pasture lands, woods, and gardens. It was this species which Mr. Paul, of Starston, in Norfolk, bred from the wireworms.*

3. *E. lineatus*, Linnæus (Plate F, fig. 26; and No. 27, fig. 2; 1, the natural dimensions); *E. striatus*, Panzer; *segetis*, Bierk., Gyll.—This insect is supposed to be a variety only of the foregoing *E. obscurus*, with the elytra or wing-cases striped, the spaces between the striæ being alternately dark and light, forming four brown and five testaceous lines. It is an exceedingly common species in various situations, and is the most frequently bred from the larvæ by those who have taken the pains to rear them: in April I have found great numbers under stones by the sea-shore; in May they were congregated upon a yellow ranunculus, or buttercup, in an ozier-holt in Norfolk. They abound also on grass, in hedges, corn-fields, &c. I have received specimens as late as July, with the pupæ and exuviæ, from Surrey. Bouché says that the larvæ live sometimes in great multitudes in dung and vegetable earth;† and it is very extraordinary, but two specimens in my collection were found on the 25th of May in the stem of a dock, and apparently feeding upon it.

* Kirby and Spence's *Introduction to Entomology*, 6th edit. vol. i. p. 147, and 7th edit. p. 99.

† *Naturgeschichte der Inseckten*, p. 187; but from Bouché's figure of the tail, I suspect it is not the larva of *E. lineatus*, but of another species of Elater.

In the other genus ATHOUS,* which is principally distinguished from Agriotes by the structure of the feet, there is only one species supposed to affect the crops, which has received, however, a variety of names in allusion to the rufous or rust colour of the belly and tail, being called—

4. *E. ruficaudis*, by Gyll (fig. 12); *E. sputator*, by Olivier; *E. hæmorrhoidalis*, by Fabricius; and *E. analis*, by Herbst.—It is long, narrow, piceous, and shining, clothed with ochreous and longish hairs; the antennæ are dusky, and similar in their relative proportions to *E. obscurus*, but they are a little longer and compressed; the basal joint is stout, second and third slender, the remainder obtrigonate, the apical one is narrower, the tip conical; the head and thorax are black, thickly and minutely punctured; the former is semi-orbicular; the clypeus truncated and reflexed; the latter is much longer than broad, a little narrowed towards the anterior angles, the posterior spines are short and trigonate, and the margin beneath projects considerably in a semicircle to receive the head; scutel black; elytra reddish brown, twice as long as the head and thorax, being rather broader than the latter, but linear, the apex ovate, and the tip of each rounded; they are minutely punctured, with nine striæ on each; the abdomen is ferruginous; legs short, ferruginous; feet appearing four-jointed until magnified; very pubescent beneath, the basal joint the longest, second and third decreasing in length, slender at the base, and somewhat trumpet-shaped, the apex being furnished with a membranous margin; the fourth is minute; the fifth long, slender, and terminated by two simple claws (fig. 27, d); length, 6 lines; breadth, 1¼ line. Abundant from April to the end of June in corn fields, on nettles, on commons, in pastures, &c. In the beginning of June, 1842, I observed this beetle flying about hedges and banks in Dorsetshire, and I had previously found it in May, by brushing the oak leaves and underwood in the extensive woods in the neighbourhood of Wilton, near Salisbury.

There is probably scarcely any land where the wireworms might not be found, and but few crops that they will not attack; but some situations are more favourable to their increase than others, and there are particular vegetables to which they undoubtedly give a preference. This may, however, in some measure, arise from the larvæ of the different species not having exactly the same tastes, and we have already shown that wireworms, the offspring of three, if not four, distinct species of elaters, attack the crops; yet some of them are so similar, except in size, that at present no tangible characters have been discovered to distinguish one from another; moreover, all root worms are called wireworms by the farmer; but in this matter we hope to

* Curtis's *Guide*, Gen. 309, No. 50.

set him right, by giving descriptions and figures of the *false* wireworms before we close the subject. At present they are accused of attacking wheat, rye, barley, oats, grass, turnips, rape, cabbages, potatoes, mangel-wurzel, carrots, onions, lettuces, hops, irises, carnations, pinks, dahlias, lobelias, and a variety of garden flowers; but in many instances the insects sent to me as the offenders were not the offspring of the elaters, and consequently were not true wireworms, but the larvæ of crane-flies and other dipterous or two-winged flies, also the juli, or millipedes, centipedes, &c.

If it be correct, and there seems to be no reason to doubt the statement,* that a wireworm is feeding five years in the earth, it is evident, from the variety of sizes one discovers of them at the same period, and about the same turnip-root, for instance, that there must be a great difference in their ages, and possibly two kinds; and as they will not voluntarily leave the field in which they were hatched until they have arrived at their perfect state and become elaters, it is impossible by any change of crops to remedy the evil, unless, indeed, one could discover some vegetable which they absolutely disliked; or by ploughing, harrowing, and keeping the soil perfectly free from weeds or plants of every kind, especially the grasses, they might be starved out. Whether they can fast for a long period is very doubtful I think, although Bierkander favours such an opinion, for it is principally in their perfect state that insects can live without food for an extraordinary space of time. Some importance, however, must be attached to the generally received opinion, that it is in all probability whilst the surface of the field is undisturbed that the eggs are deposited, consequently, the crops that follow fallows, or pasture land, when broken up, are most likely to fall a sacrifice, and that for several succeeding years; and it is the same with a clover layer; whereas, during turnips, potatoes, and similar crops, no eggs, or very few, are laid in the field; but many of those which had been deposited from one to four years previously in the grass or layer are consecutively hatching, and the larvæ are gradually increasing in size and appetite, and consequently become daily more mischievous. If a corn crop follow turnips in a field infested by the wireworms, it is astonishing if it escape being swept off entirely, for Bierkander says, "In the spring and autumn they have good appetites, and I have often observed that a single worm has bitten from eight, twelve, to twenty stalks in one place; and if one destroys so much, what may not thousands do?" For the same reason, it is almost useless to resow when a crop has been destroyed by the wireworms, unless the soil be first freed from them by repeated ploughings, when rooks, starlings, poultry,

* Bierkander kept them living on roots of corn five years, and those which I have had feeding for ten or twelve months scarcely increased in size during the time.

game, and frosts may diminish their numbers; and the farmer must remember that the wireworms *cannot* increase in number unless fresh eggs be laid by the elaters, and of this there can be no danger from the end of September to the end of March.

We will now take a review of the crops, &c., which suffer from their attacks, as well as of the soils most affected by them; but it may, I think, be received as an axiom, that wherever grass will grow, the wireworms may be found, for the roots of the various species afford sufficient nourishment for their support, and consequently pastures and meadow lands are, I expect, never free from them; and thus it follows that newly broken-up lands so constantly swarm with this pest. I believe they are most to be dreaded in dry seasons, yet they cannot be kept alive without moisture I am convinced by experience; and this is the reason that the worms are often found under stones in gravelly situations, exposed downs, dry heaths, &c.

Oats being sown upon land recently broken up are generally the crop which suffers the most severely. Dickson says:* "When this sort of grain is cultivated on such lays as are newly broken up, there may frequently be danger, especially where the land has been long in the state of grass, both from the destructive attacks of insects, and the soil becoming too light, open, and porous, from the decay of the grassy materials for the support of the plant." Such are their ravages, that sometimes it compels the discouraged farmer to lay down valuable land as pasture to a very great disadvantage; and in 1842, in many parts of England, the oat crops suffered so severely from the ravages of the wireworms, that it became necessary to plough them up and sow a second time.

When the season is dry and cold in the early spring months, the *barley* crops are frequently greatly injured by the attacks of the wireworms, which is indicated by the young plants changing from a healthy green to a sickly yellow; this was the case several years since in Surrey during the month of May, when they were eating the young barley plants just below the surface of the ground. I may also here mention that early in May, 1842, the wireworms were injuring both barley and oats at Durnford, near Salisbury; the specimens forwarded to me by Mr. Hinxman varied greatly in size, as well as others which I not unfrequently found under stones on the downs in that neighbourhood, together with specimens of the "Small Brown," *Elater obscurus* (fig. 25).

The *wheat* is also greatly injured by their attacks, which are said to be continued during the entire winter; but this, I think, is doubtful; for during

* *Practical Agriculture*, vol. i. p. 582.

severe frosts, they descend into the soil, like the larva of the cockchafer, retiring deeper and deeper as the cold increases. Early in the year, depending greatly upon the temperature, they make ample amends for their fast, if such be the case, by diminishing if not destroying this important crop. Mr. Hindman informed me that he found, in the spring of 1840, wireworms of three sizes in a field of wheat, in the county Down, near Belfast, which was eventually consumed by them, and was obliged to be ploughed up. Some young wheat plants (fig. 28) were transmitted to me in April, 1841, by a friend in Surrey, and the following account accompanied them: —"The dying off of the lower leaves indicates that the wireworm is at work, and when he has gnawed through, the plant falls. The wireworm not having eaten through, in some instances, we re-planted the wheat-root, and have ascertained by a second digging up that it was shooting again below, and it is now growing after a second planting." In these plants the wireworm had buried its head in the stem nearly 1 inch below the surface, and about ¼ inch above the roots; in other instances they were detected in the same position, but very near to the base of the stalk (fig. 29), and quite 1 inch beneath the surface of the earth, which is shown by the dotted horizontal line at fig. 28. On examination I found the tender stalk eaten through, or nearly so, for I drew it out of the sheath without employing any force, and this part was decayed and of a clay-colour for the space of ½ inch. In the same neighbourhood the wireworms were found of various sizes in a wheat stubble, where under-draining was going on in October of the same year.

Having made every effort to obtain the eggs of the elaters, in order to the ascertaining where they were deposited, I procured as many as I could of the beetles alive. Towards the end of May I put a considerable number of *E. lineatus* (fig. 26) into a garden-pot, in which some young wheat was thriving, and tied some gauze over to prevent their escape; this precaution did not, however, appear to be necessary, for they remained a very short time upon the surface of the mould before they buried themselves. From the beetles thus seeking the roots of the wheat I was led to believe that they there deposited their eggs; consequently, on the 14th of June, I emptied the garden-pot, and found two elaters dead at the roots of the wheat, but I could not detect either eggs or recently-hatched wireworms. On the 17th of May, two specimens of *E. ruficaudis* (fig. 12) were found upon the wheat-leaves, also, *E. sputator* (Plate G, fig. 34), and *E. marginatus* (fig. 36); on the 31st, one of *E. murinus* (fig. 32), four of *E. fulvipes* (fig. 33),* one of *E. lineatus*

* These four insects will be figured in the next plate, which will appear in the succeeding chapter.

(fig. 26), and one of *E. sputator*, as well as others in the hedge surrounding the field; and it is probable that if any one had searched the clover fields, the oats, or the barley and clover fields, the elaters would have been found in great numbers; for, as we have stated, wheat after clover-lays is more devoured by the wireworms than after anything else, and they had worked both the barley and oats when young in that locality. June 2d, received about twenty specimens of *E. lineatus*, found in the evening in a wheat field in the same neighbourhood; but on June 16th the elaters were no longer abundant there: they had paired; after which the males, I expect died; and the females, I imagine, had entered the earth to lay their eggs: and I hope that some one more fortunate than myself will soon prove whether such is their economy.

At the same time I placed in another garden-pot, having wheat and a potato growing in it, some of the larvæ, or wireworms. On examining the plants on the 14th of June, I found the base of the stalks perforated, the worms had descended 2 or 3 inches deep, where they had formed cells (fig. 10), as if they were inclined to change to pupæ, and the earth was full of their burrows. Having kept the pot in a saucer of water, they thrived well, but others not kept moist invariably died; if they had not been unseasonably disturbed I have no doubt they would have undergone their regular metamorphoses; for, on the 26th of July, some kept by a friend in a pot had cast their dark skins, and were become white pupæ, like fig. 11. Having had opportunities of examining a very large number of wireworms, I am able to state that some are nearly destitute of hairs, especially the smaller ones, which appear to me to be the most numerous. My opinion is, that the smaller ones are very often the larvæ of *E. lineatus* and *E. obscurus*, and the larger ones of *E. ruficaudis*, and some may belong to the smaller species of elaters, which will be hereafter figured and described.

Potatoes suffer greatly in some counties from the wireworm, whilst in others, where that animal equally abounds amongst the turnips, the potato crops escape. This is a very remarkable fact, and resembles the curious anomalies in the black caterpillar, which in some districts would not touch the Swedish turnips, and in others would feed upon nothing else;* consequently we see it asserted by one writer, that the wireworms will not eat the potato,† whilst others as confidently affirm that in many localities the annual produce has been reduced to less than one-third.‡ Owing to these counter-statements, when I was at Glanville's-Wootton, near Sherborne, in Dorset-

* Chapter ii. p. 50. † *Transactions of the Yorkshire Agricultural Society*, p. 65.

‡ Remarks on wireworms which seriously damaged the potato crops, &c., in *Transactions of the Entomological Society*, vol. iii. p. 154.

shire, in October, 1840, whilst the potato-digging was proceeding, I made strict inquiries concerning the wireworms, and in a piece of common land, which had been broken up previous to forming a plantation, I found great quantities about the potatoes, and they infested all the potato fields which had been lately common land, and newly-inclosed and broken up, notwithstanding the whole had been pared and the turf previously burned.* Some of the worms had eaten into the hearts of the potatoes; and at Shaftesbury I learned that the potato-crops had suffered considerably from this little animal. Mr. Hope also says:†—"On observing several potato plants just above the ground in a drooping sickly state (without an aphis on them), I was induced to dig them up. In many instances I found the wireworm at work, and adhering to the slices which had been planted; others apparently had been partially eaten, were abandoned, and in a forward state of corruption. Where the plants did *not come up*, which was the frequent occurrence in 1838, I am inclined to think the *slices* were entirely eaten, as not a vestige of them could be found." Mr. Hope attributes the disease, which is denominated the *Curl*, to the wireworms; but that I think is very doubtful. He adds, that they first attack the potato when the slices are first committed to the earth; and secondly, when the haulm is considerably grown. Mr. T. A. Knight's plan of planting *whole potatoes* instead of slices would at once remedy the evil.

We learn also from Mr. Hope's remarks, that the *hops* in Kent, Worcestershire, and Herefordshire, have been repeatedly injured by the wireworm.

Cabbages are frequently destroyed by the wireworm. A gardener in Wiltshire says, that in 1829 it was with the greatest difficulty he could bring any of the brassica tribes to perfection;‡ and this may be readily imagined, for I have found great numbers of the wireworms in the clubbed roots of cabbages, especially in the autumn.

It is, however, the *turnip*, amongst the green crops, which suffers the most severely, I apprehend, from the wireworms; and it is very remarkable that this invaluable vegetable should have the greatest number of formidable insect enemies to encounter, as we have already shown in the five preceding chapters. I believe there is no period of the year, if the winter be not very frosty, when they may not be found at their roots. It is, however, to the young plants that they do the most serious injury. On visiting the turnip fields at Rougham, in Suffolk, with Mr. E. Bennet, we found the plants

* The numbers of wireworms which infested the land after this operation, in all probability came from surrounding spots and boundary lines, which were still covered with turf, and had not been subjected to this process.

† See *Transac. Entom. Society*, vol. iii. p. 154.

‡ *Gardener's Magazine*, vol. v. p. 610.

looking sickly and the outer leaves yellow; on drawing them up a wireworm was invariably detected round the root of each, which had been gnawed by it (fig. 30); Mr. Bennet also observed them engaged in the same way in the beginning of August, 1840. The worms varied in size from 1½ line (being the smallest I ever saw) to 4 lines, and latterly to ¾ inch, and in some instances two or three were attacking the same root. On the 9th of November in that year I found a wireworm, as large as the one represented at fig. 2, at the root of a turnip, in a garden, and others of the same size have frequently occurred since. In September of the same year the wireworms were very abundant in Surrey, from six to eleven being found at a single turnip-root; the fact is, that as the plants are destroyed and deserted by them, they march off to the nearest, and thus meeting at one spot they daily become more formidable to the remaining crop. They ate off the root from ½ to 1 inch below the base of the leaves, and it was often gnawed higher up (fig. 30, *e*). With these wireworms was a snail (*Helix*), then alive, but being left together in a box, the former attacked and ate up a portion of the latter, and six of them were found within the shell at one time: from this it seems that they are sometimes carnivorous. In the western counties the wireworms appear to have been still more formidable, for Mr. Hope says:*—"In the counties of Salop, Worcester, and Hereford, the failure of the crops of 1838 was very considerable, the real cause of it being little suspected or understood: I feel no hesitation in ascribing it almost entirely to the wonderful increase of wireworms. In some instances I have, during the years 1836 and 1838, taken twenty and even thirty wireworms feeding upon a single turnip-root."

Mr. Le Keux has not neglected to attend to the economy of the wireworm, in his investigations of the insects affecting the turnips;† and from his observation it appears that the *foliage* as well as the root is equally acceptable to them. He says, "The wireworm begins on the edge of the leaf, and eats it away like a caterpillar, and often cuts the leaf off at the top of the stalk; and it may sometimes be found on the ground half devoured. One wireworm will consume about as much as five or six beetles or flies (*Altica nemorum*) could do in the same time." The following remarks, by the same accurate observer, throw so much new light upon the economy of this destructive animal, that I need not make any apology for laying them before the reader:‡—"The wireworm," he states, "seldom feeds above ground in the day-time, unless it be cloudy and dark; at such times I have observed them devouring the young turnip plants before the rough leaf has been formed; but their most destructive operations are carried on beneath the surface of

* *Trans. Entom. Soc.*, vol. iii. p. 155. † Ibid. vol. ii. p. 32. ‡ Ibid. vol. ii. p. 30.

the earth, where they attack the root; in the very early state of the plant, after eating this through, the upper part of the plant is gradually drawn down into the earth and devoured, so that the plants disappear without any perceptible cause, and without any trace of them being left. In the more advanced state of the plant their devastation appears to be confined to eating through the root; and having thus killed one plant, they proceed to another. If a turnip plant appears drooping (as if from the want of water), whilst those in its neighbourhood are fresh and erect, a wireworm (sometimes half-a-dozen) will be sure to be found at the root, if the earth around it be carefully removed."

If noxious insects be dreaded by the farmer, the gardener has no less cause to apprehend their mischievous assaults; and from the great variety of these animals to which his culinary vegetables, as well as the fruits of the orchard, fall a sacrifice, they become, in truth, domestic plagues, which are brought to his own door. Amongst them are the wireworms, especially those produced by the beetles called *Elater obscurus* (fig. 25), and *E. sputator*—this last is abundant everywhere; and in the spring and summer the gardener often has the misfortune to see his newly-planted lettuces suddenly commence withering and dying: on pulling or digging up such plants, a wireworm is found at the roots, considerably like a mealworm, but more flattened, of a pale yellow, from 6 to 7 lines long, and about the size of a pigeon's quill.

We learn from Köllar* that the larva of *E. sputator*, Fab.,† undergoes its transformations in the ground, and remains only fourteen days in the pupa state, when the beetle is produced. This dangerous enemy has been known to destroy one-fourth part of the crop by gradually eating the roots up to the crown of the plant where the leaves arise. Not only ought the earth to be immediately removed from the roots of the affected plants, the worms taken away, and the earth returned to its place, but, if necessary, the lettuces had better be dug up, and the worms which are concealed in the roots or in the surrounding mould can be destroyed: thus the rest of the crop may be saved; otherwise the worms will travel from dying to living plants until all the lettuces have fallen a prey to this annoying enemy. The beetle is particularly attached to the flowers of the *Umbellatæ*, and to nettles; it is, therefore, most important for the gardener not to neglect destroying the fool's-parsley, hemlock, and all similar wild flowers, which harbour them and constantly spring up on the banks and hedges round his grounds.

As it is in the field so it is in the garden; "the wireworm is particu-

* *Naturg. der schaed. Insect.*, p. 149.

† It is impossible to say if he intends the Linnæan species; I think not, and am rather disposed to consider it the *E. ruficaudis*, but it is very doubtful.

larly destructive for a few years in gardens recently converted from pasture ground. In the Botanic Garden at Hull thus circumstanced a great proportion of the annuals sown in 1813 were destroyed by it."* At Bordeau House, Hants, Captain Chawner's flower borders have been frequently infested by the wireworms, which ate into the base of the stems of the pansies and carnations, ascending them sometimes 2 inches above the ground. They revel also on the roots of the dahlias and lobelias. On the 5th of May I received two wireworms of different sizes from a flower garden in Surrey, and precisely the same as those from Hampshire; towards the end of the month four examples of the *E. ruficaudis* (fig. 12), and one of *E. fulvipes* (fig. 33, Plate G) were found on the side of the house there, most likely bred from the borders. About the same time three very small wireworms were found in the flower garden, and in the beginning of August I received a pupa, I believe, of *E. ruficaudis*, with the exuviæ of others and their earthen cases, from the same locality. Mr. Smith, in the *Florist's Magazine*, says—"The wireworms invariably attack the pink and the carnation at the bottom of the stem near the root, and make holes through it in every direction, while the only indication of their presence is the entire destruction of the plant. The larva is in general found in the loam, therefore great care should be taken, in sweetening that soil, not to allow one to escape when it is turned over; and their colour being a light brown, makes the finding of them more difficult."

Wishing to render the history of the wireworms as complete as my materials will allow, and being greatly attached to the garden, which may be considered a farm in miniature, I have made this slight digression, and will now return to our legitimate object. Having, in 1842, obtained some facts from practical men highly esteemed in the county of Suffolk for their agricultural knowledge, I shall now give the results of their experience.

Mr. Porter, of Covehithe, where the lands are for the most part light, says that the wireworms do most mischief in March, April, May, and June; that wheat suffers the most among the corn crops, and white turnips amongst the green crops, but that rye is sometimes swept off by acres; and with regard to barley, he has observed that when it is drilled in 3 inches deep, the plant droops and turns yellow, as if attacked by the wireworm, whereas, at 1½ inch deep, it makes a vigorous plant. I may observe with respect to this difference of result from the depth of sowing, that it is possible the wireworm may not be able to exist near the surface in a light sandy soil, and consequently the barley escapes when drilled in at the lesser depth. Turnips

* Kirby and Spence's *Introd. to Ent.*, 6th edition, vol. i. p. 147, and 7th edition, p. 99.

and beet-root he finds most affected in the end of June and the beginning of August, yet 12 acres of the latter, which produced a fine plant, were completely taken off by the wireworm in the last week in May; Swedes were afterwards sown in the second week in June, and to his surprise produced a fine crop. The success of the Swedes must be attributed, I think, to the greater part of the wireworms having arrived at maturity when they had destroyed the beet, in which case they would change to pupæ, and afterwards to beetles, in both which states they are harmless. Turnips do best at Covehithe if sown about the 21st June on the light lands, and a week earlier on heavy lands. On the lower part of fields bordering on marshes, where the land is springy and friable, barley, turnips, and beet have generally fallen a sacrifice to wireworms, and such land is most subject to their attacks. When white clover or suckling and rye-grass layers have been left for seed, it is scarcely possible to get a wheat crop on account of the wireworm; the only chance is to break up the land and work it well about for a couple of months in the autumn. Potatoes never suffer on Mr. Porter's farm from the wireworm.

Mr. Robinson, of Henstead, informs me that in his neighbourhood the gravelly and sandy soils are most infested, and the strong loam and clay most free from the wireworms. That they inhabit every aspect was proved by their ravages over all parts of a field which was lowest in the centre. A dry season is most conducive to their increase, yet if the following year be wet it does not kill the wireworms, but it probably destroys the elaters, and prevents the deposition of the eggs. Early in March, 1841, when his wheat was well out of the ground, and about 1½ inch high, it began to die off, and on pulling some up he found the wireworm had eaten into the stalk and consumed the inside. This was upon dry gravelly hills which had been a clover layer, and the valleys and better parts of the field did not suffer, but barley on strong land in the same parish drilled in the spring did not produce above one-third of a crop owing to the attacks of the wireworms. Some low wet common land was broken up, *pared* and *burned* (which with the draining cost £10 per acre); it first produced a good crop of turnips, and afterwards a prodigious crop of oats; but another portion under a different owner was pared but *not burned*, and the crop was lost.

Mr. Bate says that the following is the order in which the crops probably are affected in degree in his part of Suffolk, viz.—wheat, turnips, barley, oats, and beet, and that they are generally least injured on good soils. If wheat be sown in dry weather it has proved favourable to the inroads of the wireworm. Oat stubble ploughed several weeks previously, and sown with wheat the third week in November, suffered from their attacks. Barley and oats were injured in May, in a cold wet season. Turnips have been swept off after being up a fortnight, but generally they fall a sacrifice when three or four weeks old, having at that time four or six leaves; yet he finds the eating through of the tap-root after the second hoeing does little mischief to the turnip-plant. That all lands exposed to the sun by being fed off short, as clover layers, are greatly infested with the wireworms, but that no potato crop is destroyed by them.

From these statements it is evident that in some parts of Suffolk the potato crops escape the attacks of the wireworm, although that animal is abundant in the soil. It seems to be the same in Yorkshire, for Mr. Milburn* was so convinced of the potato being exempted from the ravages of the wireworms, that he even recommended it as a good crop to plant in order to starve them out and clear the land of that pest: he says, "Nobody ever heard of a potato crop being injured by them;" and, alluding to Sir Joseph Bankes' mode of ridding gardens of wireworms by sticking slices of potato in the ground, he adds, "It is really surprising how a person so truly above all visionary theory should be led to recommend such useless plans."† We must, however, be very careful in drawing positive conclusions, for there is unquestionable evidence of the potato crops suffering severely from the depredations of the wireworm in Dorsetshire, Wiltshire, and the western counties. The valuable memoranda I have just given from the experience of practical men will, it is to be hoped, induce others cultivating land of a different nature to attend to this subject; for it is for want of correct and an extensive variety of data that we are at a loss to account for many anomalies in the economy of insects; indeed, it is impossible to draw correct conclusions from isolated facts.

Difficult as the wireworm is to deal with, so much attention has been paid to the subject by the suffering farmer and gardener, that numerous methods of arresting its ravages have been tried, some of them with great success; and let not any one be discouraged because he cannot clear his land entirely, or at one blow sweep away a nuisance, for extermination amongst these minor works of the creation is not permitted; it is against the laws of the Creator; for although such intervals of absence may occur as to lead us to think that a noxious animal is annihilated; it will in due time return, and again require all our efforts and vigilance to contend against it. We are sometimes deceived by appearances, and it is true that by persecuting the higher order of animals, they may be driven from a favourite spot or locality, and take shelter so far from the haunts of man as to relieve him

* Of Thorpfield, near Thirsk.

† *Journal of the Yorkshire Agricultural Society*, p. 65.

from their inroads, and dispose him to imagine that the species is lost; and in some instances we know that a country has been freed from races of animals, as the wolf and eagle, but they are not exterminated; and the latter, under favourable circumstances, would return; I think it therefore probable that by perseverance insects may be driven from a locality, for persecution is not agreeable to any animated being; and this knowledge ought to encourage the cultivator not to relax in his efforts to free his land from destructive insects, but to be certain that those efforts are well directed.

Great benefits may be derived by selection of crops, by modes of cultivation, by manures and dressings, but, above all, by manual labour. Animals also whose economy tends to diminish destructive insects ought to be encouraged, and no doubt we are benefited, to an extent which it is impossible to conceive, by the parasitic insects whose instincts lead them to prey upon the eggs and caterpillars of our enemies: they are, as we have shown in former chapters, multiplied to an almost incredible extent, and labour incessantly in their vocation. These are discoveries which have been gradually developed by the industry, perseverance, and research of the naturalist, for the improvement, amusement, and benefit of his fellow-creatures; and I concur entirely with Mr. Hope, that "agriculture may derive valuable assistance from the science of entomology; and I feel fully convinced that we can scarcely do a greater act of kindness, or be of more service to the farmer, than by pointing out the nature and habits of those insects which destroy his crops."*

We will now return to the opinions of practical men regarding the best modes of culture for keeping in check the wireworm; a great deal, however, must depend upon the soil and situation, which will often explain the reason of an experiment succeeding in one place and failing in another. Mr. Salisbury gives some good advice concerning the wireworm.† "It is an insect," he says, "much complained of by farmers whenever they turn up land that has been cultivated with clover or grass, and it in general does great injury to the corn crop which succeeds. It should be noticed that clover, or other plants of such description, give protection to this insect; it is bred in the roots of these plants, and the land is so well stocked with it that it attacks the corn and other succeeding crops very much to their injury. Land of this description is therefore unfit for corn immediately on breaking up. Turnips or potatoes are not so liable to injury from this insect; but the best preventive is probably a summer fallow, and burning the rubbish on the land before cropping, by which means the eggs which are laid in the stalks are destroyed,‡ and the live worms die for want of nourishment; soot and lime will also kill

* *Transactions of the Entomological Society*, vol. iii. p. 156.

† *Hints to Proprietors of Orchards*, p. 109.

‡ No authority is given for this statement.

this destructive worm. Before breaking up old lays it should always be a point with the farmer to examine the then existing crop, and observe if any of these insects are in the roots and stalks, and if so, to apply the above as a preventive previous to sowing a crop of grain in the land. Nothing but the preventing such a pest as this insect will justify the fallowing of land according to our improved system of agriculture; in this case, however, it is indispensable. May not this insect, which is now (1816) more prevalent among our crops of grain than ever, owe its prevalence to the system of fallowing and burning the refuse of such crops being nearly exploded?" Fallows must, however, be kept very clean, for if couch and other grasses be allowed to exist in the land, the wireworms will find the roots very acceptable, and sufficient to maintain them until the corn-crop appears; nothing can therefore be worse than to leave strips or spaces of grass or stubble in a ploughed field.

All waste and wood lands are harbours for the wireworms, and therefore when they are brought into cultivation the change is so congenial to their habits that they seem to increase at a prodigious rate, and consequently the second crop is frequently carried off by them. If land be planted or sown two years in succession with the same crop, it is sure to be well stocked with them, at least so it is with the potato. When old pastures are broken up for a crop of corn, I have heard that a breast-plough should be used to take off not more than 2 inches of the turf in the first instance, which will secure the crop from the attacks of the wireworm, whereas even the addition of only 2 inches more in the depth has so encouraged that pest that it has been known to destroy an entire field of wheat. This difference probably arises from the effects on the roots of the grass; if the top of the turf only be pared off, the roots will die, whereas by going 4 inches deep they lie and vegetate, so that when it is afterwards all ploughed in, the worms find the requisite pabulum, until the corn is forward enough to afford the wireworms a more agreeable substitute. Dickson says that the destructive attacks of insects on lays newly broken up, "may, in some measure, be obviated by eating such lands very closely with sheep, previous to their being broken up, as by such a method the ova of such insects may be much destroyed and their propagation prevented; and the treading the crop by sheep, as well as the roller, may likewise be beneficial; horses have also been turned in for the same purpose by some cultivators."* It is supposed by many that folding oxen and sheep upon infested fields will check the wireworm by stopping their burrowing; but it seems more likely to arise from the beetles not being able

* *Practical Agriculture*, vol. i. p. 582.

to get out of the earth from their pupæ cases, and those which do effect their escape, finding no appropriate place for the deposition of their eggs, depart for a more suitable locality; this operation might therefore be most advantageously adopted early in the spring before the beetles hatch.

Mr. Bate assured me that he always preserved his turnips by harrowing and hard-rolling in March and April, and that it was of no use later in the season. In another place, alluding to barley, Mr. Dickson also says,* that if the plants suddenly change from a healthy green to a yellow cast, "the use of the roller should be had recourse to, in order that the superficial parts of the soil, which are probably become too loose and porous, may be effectually pressed, and thereby rendered too close and compact to admit the worm to prey upon the tender roots of the young plants. That this effect may be produced in the most effectual manner, the roller should be of such a size, or so loaded as to afford a pressure equal to the draught of three or four horses, which should be yoked double, in order to increase the effect by their treading. It has been suggested that if by this method the injury can be counteracted until such time as rain falls, there need not be any apprehension of the crop, as the plants will soon push forward in such a manner as to become too strong to be in danger from this insect."† Top-dressings of lime before using the roller would be useful. All this is very reasonable, for by excessive pressure the wireworms are compelled, at least for a time, to descend into the earth; and it must be beneficial in its subsequent effects, for numbers of eggs may thus be destroyed, and if rain fall it will so cement the earth together that the beetles when hatched will die in their tombs.

There are some *crops* which appear to be extremely useful in keeping the wireworms under, and amongst them is *woad*. I learn from Dr. Roy, that, on breaking up damp meadow and pasture land in Lincolnshire, if it be sown with woad instead of corn, the wireworm will be got rid of; and about Boston it is found to be a very profitable crop. It may be repeated for two years, after which splendid crops of oats and potatoes may be obtained from the land. It may not be irrelevant to remark here that it is a prevailing opinion respecting the Bedford Level, that *over-draining* has caused great mischief to the wheat crops by increasing the wireworms.

White mustard-seed sown on land will secure the succeeding crop of wheat or other corn against this insect; and Mr. Tallent's† account of his success being satisfactory, I shall transcribe it:—"White mustard-seed will protect the grain from the wireworm, and this fact I have demonstrated perfectly to my own conviction. I first tried the experiment on half an acre,

* *Practical Agriculture*, vol. i. p. 576.

† Dickson's *Synopsis of Husbandry*, p. 91.

‡ Of Little Houghton.

in the centre of a fifty-acre field of fallow, which was much subject to the wireworm. The mustard-seed being carried, the whole field was fallowed for wheat, and the half acre that had been previously cropped with mustard-seed was wholly exempt from the wireworm: the remainder of the field was much injured. Not only was the half acre thus preserved, but in the spring it was decidedly the most advanced part of the crop; and the prosperous appearance which it presented caused me to repeat the experiment, by sowing three acres more of mustard-seed in the worst part of a field of forty-five acres, also much infested with the wireworm. The remainder of the field was sown with early frame pease, which, with the mustard-seed, was cleared in the same week. The land was then ploughed for wheat; and I had the pleasure of noticing these three acres to be quite free from the worm, and much superior in other respects to the other part of the field, which suffered greatly. Thus encouraged by these results, I sowed the next year a whole field of forty-two acres, which had never repaid me for nineteen years, in consequence of nearly every crop being destroyed by the wireworm; and I am warranted in stating that not a single wireworm could be found the following year, and the crop of wheat throughout, which was reaped last harvest, was superior to any I had grown for twenty-one years. I am therefore under a stong persuasion that the wireworm may be successfully repelled and eradicated by carefully destroying all weeds and roots, and drilling white mustard-seed, and keeping the ground clean by hoeing." *

Mr. Loudon is of opinion "that the wireworm cannot eat the roots of the mustard, most probably from their acridity, and there being no other roots in the soil for them to live on, and no weeds or other plants than mustard being permitted to grow during the season, the insects necessarily die of famine." †

Mowing oats, and of course other corn, is considered the best method of getting rid of the wireworm by Köllar, and other continental writers; but they assign no reason, and it is difficult to explain the cause. It may be, that when corn is reaped, the stubble being left long, rooks and many other birds will not resort to such fields, and consequently, the wireworms revel without molestation. This is worth the consideration of the farmer; and whatever may be the cause, if the statement be true, it ought not to be neglected. Long stubble certainly harbours many injurious insects, and amongst them, it is believed, the turnip-beetle, which resorts to the long hollow straws for shelter during the winter. ‡

* Read before a meeting of the Northamptonshire Farming Society, and inserted in the *Country Times*, September, 1831.

† *Gardener's Magazine*, vol. vii. p. 675.

‡ Chapter i. p. 26.

I will now give the experiments made by Bierkander; and although their application to the crops may not be so beneficial as one could desire, yet they may be useful in directing the cultivator in the pursuit of this subject. "I have," says this learned Swede, "made many experiments to discover by what means the wireworms may be destroyed. Many were put at one time into tea-cups filled with the following vegetables, viz.:—

		Days.	Hours.
Garlic, ...	amongst which they lived, .	9	0
The leaves of the spruce fir, . .	ditto .	0	14
The leaves of the fir, ...	ditto .	0	10
Ledum palustre (an Irish plant), . .	ditto .	0	9
Myrica gale, sweet gale, or Dutch myrtle,	ditto .	0	2
In water they lived, ...	ditto .	4	0

"In consequence of this it ought to be tried how useful it might be, in winter and summer, to mix in the heaps of manure fir leaves, *Ledum palustre*, and *Myrica gale*, of which vegetables the dung would smell, which might probably be disagreeable to the vermin; and if they did not die in consequence of it, they might perhaps quit the fields."*

It thus appears evident that any endeavour to destroy the wireworms by drowning them is almost impracticable; for they not only exhibited signs of life in water for four days, but I think it probable that if a field were laid under water for a much longer period, it would not destroy them. This, however, might be easily tried in some situations; and to ascertain the truth is worth the trouble.

Lord Albemarle recommends that when fields intended for wheat are attacked by the wireworms, rape-cake should be used as a manure, to be powdered, and sown across the field. If it do not destroy the insects, it at least saves the crop from their attacks.

Many other applications have been recommended, and amongst them spirits of tar and chloride of lime. One correspondent in the *Gardeners' Chronicle*† says, "Spirits of tar is the most effectual remedy with which we are acquainted for destroying the wireworm. We should therefore recommend any one to saturate some sand with that compound, and mix it with the soil in the beds of ranunculus and anemone when they are turned up in autumn." J. W. C.,‡ having lost his crops from wireworms, also says, "Thinking that spirits of tar might do good, when I sowed dwarf French beans again, before covering in the rows, I watered them with a strong solution of it; and the result was that they came up very strong and healthy,

* *Trans. Acad. Scien. in Sweden*, vol. for 1779, p. 286, and *Commun. to Board of Agric.*, vol. iv. p. 414.

† Vol. iii. p. 233.

‡ Ibid. p. 737.

and the produce was enormous; whilst the first crop gradually dwindled away, and died a premature death." "The refuse lime of gas-works is stated to be efficacious in banishing these pests from the garden. Previously to the crop being planted, a thin covering of the lime should be spread over the ground, and it must be well mixed up with the soil in digging."* F. H. B. "had been using some chloride of lime water, and poured it over some grass, when it immediately killed the worms. From this success he was induced to try it on some very sickly carnations infested with wire-worms, and had the satisfaction to find them recover rapidly. The proportion used was about a table-spoonful to a pint of water, but that of course must depend on the quality of the soil."† It seems necessary to employ it with caution, in the flower garden at least; for in the same journal it is asserted, "We have great doubts whether chloride of lime, although considerably diluted, would not be injurious to picotees, and commit as much havoc amongst them as the wireworm. We recommend you to spread some of the refuse lime from the gas-works over the surface of the bed, the effluvia of which will probably drive them away."‡

In the *Journal of the Royal Agricultural Society*, Mr. Burgess § says, "This year I applied the *nitrate of soda* to my wheat, when, from the wet season and the wireworm, the plant was nearly destroyed, and I found it particularly beneficial, the wireworm either being killed by the application or forsaking the roots; and consequently I think I have above an average crop of wheat." The ammonia which invigorated the plants at the same time destroyed the insects; and it is added that the turnips grew so fast that they soon got out of the way of the beetle or fly (*Altica nemorum*).

It is also positively affirmed that if *lime and soot* be applied to the soil before sowing any grain, it will kill the wireworms. *Salt*, likewise, on light sandy soils, is highly efficacious in destroying them; and of its effects upon these animals it is in the power of every one to convince himself, and also of the strength required for their destruction, by dissolving a tea-spoonful or more of salt in a tea-cupful of water, with some wireworms in another, half full of pure water, when, by adding the salt water by degrees, the exact effect produced upon the life of the animals will be ascertained; and the same of course may be done with spirits of tar, &c. In alcohol the wireworms expire in five minutes, but spirits of turpentine destroys the vital principle almost instantaneously. It is, however, difficult to kill them by a change of temperature, and yet in an artificial state it is extremely difficult to rear them.

* *Gardeners' Chronicle*, vol. ii. p. 777.
† Ibid. vol. iii. p. 318.
‡ Ibid. vol. ii. p. 777.
§ Elmhurst, Bucks. See *Royal Agric. Journ.*, vol. ii. p. 132.

As the wireworms will live upon potatoes—as I can testify by having fed them on nothing else for many weeks together—there cannot be a better bait to catch them in the flower borders than slices of that tuber, as recommended by Sir Joseph Banks, which has been fairly tried by a friend in Hants, who tells me it is the only method by which he can save his carnations and other flowers. I have now before me communications from several contributors to the *Gardeners' Chronicle,* all concurring in recommending slices of potato, &c., as the best mode of freeing the garden at least from this troublesome visitor. One of these I will transcribe:—"I send you an account of destroying the wireworm, which I have adopted for some years, my ground being full of them, so that I could neither grow sweet-williams, picotees, bulbs, lettuces, nor indeed any succulent plant, without their boring, running up, and eating the hearts out. Near these plants I now place half a potato, with the eyes cut out to prevent its growing, and run a pointed stick through the middle of it, and peg it into the ground, covering it over with about 1 inch of mould; and in a day or two I have pulled out by the tail from fifteen to twenty of them from one piece of potato."* Slices of turnip, broccoli, cabbage, beet-root, parsnip, carrot, apples, and young lettuce-plants, will answer the purpose where potatoes are scarce or not to be obtained; and it is very probable, if such vegetables were scattered over infested corn fields, that considerable numbers of the wireworm would be decoyed to them, and might be collected and destroyed; for it is even recommended by some persons to lay the slices of potato on the surface, although there are others who consider that they may be buried 2 or 3 inches deep: but these variations in the mode of application arise, in all probability, from differences in the soil.

Excellent as many of the foregoing remedies may be, I must confess I think highly of *hand-picking;* its effects are certain, it is comparatively not expensive, especially when it is borne in mind that it gives employment to the children of the labourer; and where the wireworms swarm it must be successful, as will soon be demonstrated. What must have been their amount in a field shown to Mr. Spence, "in which," he says, "they had destroyed one-fourth of the crop; and the gentleman who showed them to me calculated that his loss by them would be £100. One year he sowed a field thrice with turnips, which were twice wholly, and the third time in great part, cut off by this insect."† Bierkander, after all his experiments, appears to have depended most upon hand-picking; for, he says, "in a field where rye was intended to be sown, I last autumn (1778) employed a child to follow

* Adan, in *Gardeners' Chronicle,* vol. iii. p. 301.

† Kirby and Spence's *Introd. to Entom.,* 6th edition, vol. i. p. 154, and 7th edition, p. 104.

the plough and pick up the worms; by this means 351 were collected in a piece of land 600 feet long and 56 broad. The quantity which was taken in other fields was not counted. There were caught in the furrows, according to their length, 4, 6, 10, to 14 worms. It would be serviceable if children always followed the plough, and gathered these yellow worms into a bottle; they would by that means be considerably diminished, and perhaps in time entirely exterminated."* The following fact shows the advantages of this system, and requires no comment:—"A striking instance," says Mr. Spence, "of the use of hand-picking (in most cases by far the most effective mode of getting rid of insects) appeared in the *West Briton*, a provincial paper, in November, 1838, stating that Mr. G. Pearce, of Pennare Goran, had saved an acre and a half of turnips, sown to replace wheat destroyed by the wireworm and attacked by hosts of these larvæ, by setting boys to collect them; who, at the rate of 1½*d.* per 100, gathered 18,000; as many as fifty having been taken from one turnip. Thus at the expense of only £1, 2*s.* 6*d.*, an acre and a half of turnips, worth from £5 to £7, or more, was saved; while, as the boys could each collect 600 per day, thirty days' employment was given to them at 9*d.* per day, which they would not otherwise have had."†

Mr. Eley, of Heathfield Farm, Hounslow, communicated to me the following statements regarding "three acres of wheat (drilled) infested by wireworms, and which we hand-picked by women, in March, 1846:—The dead plants were dug up with square-pointed knives, and the wireworms picked from the roots into small jugs; at the end of every two rows they were emptied into a large jar, from which escape was impossible. The total quantity taken and destroyed in this manner, from the three acres alone, was more than 60,000; the expense of collecting them was trifling, being not more than 10*d.* per 1000, at which price the women can earn good wages. The ground was gone over two or three times, and the worms were counted every night." "And in June, 1845, we had five acres of Swedish turnips very much affected by them; a woman was set to dig the plants that were dead and dying, and to pick up the worms; she was seventeen days, at 1*s.* per day, and collected 41,600: (*this quantity is quite correct*). The wireworms are much easier caught from the turnips than wheat: as many as twenty-five in several instances have been found attacking a single plant."

As *birds* and *animals* are the farmer's best friends, I shall always advocate their cause, and to establish their claims I shall quote various good authorities who have borne testimony to their utility, in addition to those which have been already given. Amongst the birds, that which stands first and

* *Commun. to Board of Agric.*, vol. iv. p. 414.

† Kirby and Spence's *Introd. to Entom.*, vol. i. p. 154, and 7th edition, p. 104.

foremost in the ranks is the *rook;* wary as he is on most occasions, he follows the plough fearlessly, to feed upon the wireworms and other insects; and here his services are most invaluable, for if you dig up the wireworms and lay them upon the earth, they will often burrow down and disappear in a few seconds; many, therefore, of the feathered race have little chance of catching them in the ploughed field; but the form of the bill, combined with the strength and assiduity of the rook, is well adapted for detecting them in their hiding-places. To pick them from the growing crops is likewise the occupation of the rook when we see him gravely surveying a turnip or corn crop, and with astonishing sagacity selecting those plants only which have a few yellow leaves outside, the sure indication of the presence of the wireworm and other insects. A gentleman in Norfolk, who well understands this subject, says, "The rooks convey the first tidings of the presence of this formidable enemy by hovering over a field in flocks, and actually pulling up the turnips by the roots to search for them, and I cannot but believe that their sagacity directs them to the infested plants, which are distinguished by their drooping leaves and dark unhealthy aspect."* An equally observant friend, in Surrey, says, "The rooks are accused of doing injury by pulling up the wheat, but I, as well as others here, believe that they pull up the attacked plants to get the wireworms, and do not touch the healthy plants." The bailiff to the same party informed me, during a period when the wireworms were abundant, that the rooks had been busily occupied amongst the barley in May, and where it looked sickly had drawn the earth away from the roots to find the wireworms, and where they had been "working the earth" he could not find any of the worms.

But there is still stronger and incontrovertible evidence in their favour, for in the stomachs of rooks which have been shot when following the plough in barley-sowing, a few grains of corn only were found, but abundance of wireworms and other insects. Mr. J. Denson, sen., says, "I have repeatedly examined the crops of rooks: in six young that had been shot the crops were nearly filled with wireworms; in the crops of others I have found the larvæ of the cockchafer, and other grubs that I am not entomologist enough to know the names of. In one or two instances, in frosty weather, I have examined the crop of one or more rooks that had been shot: it contained dung, earth, and a small portion of grain. I will just notice that the land adjoining Mr. Wiles's rookery is yearly sown with pulse or grain, and in no instance have I known or heard that the land has in consequence failed of a crop."† The following remarks, also, by Mr. T. G. Clithero, are exceedingly interesting:

* T. S. N., in Preface to an *Abstract from Marshall's Rural Economy of Norfolk*, p. x.
† *Gardener's Magazine*, vol. ix. p. 718.

—"In the neighbourhood of my native place, in the county of York, is a rookery, belonging to W. Vavasour, Esq., of Weston, in Wharfdale, in which it is estimated that there are 10,000 rooks; that 1 lb. of food a-week is a very moderate allowance for each bird, and that nine-tenths of their food consist of worms, insects, and their larvæ; for although they do considerable damage to the fields for a few weeks in seed-time and a few weeks in harvest, particularly in backward seasons, yet a very large proportion of their food, even at these seasons, consists of insects and worms, which (if we except a few acorns and walnuts in autumn) compose at all other times the whole of their subsistence. Here, then, if my data be correct, there is the enormous quantity of 468,000 lbs., or 209 tons, of worms, insects, and their larvæ, destroyed by the rooks of a single rookery in one year. To every one who knows how very destructive to vegetation are the larvæ of the tribes of insects, as well as worms, fed upon by rooks, some slight idea may be formed of the devastation which rooks are the means of preventing."* Wagtails and robins are also very fond of the wireworm, and probably sparrows; blackbirds and the thrushes are constantly hunting the grass for them and other larvæ and pupæ.

Pheasants and partridges are likewise exceedingly beneficial in this respect, and in some measure compensate the farmer for the loss of the rook, crow, &c.: when we find the game in the turnip fields they are usefully employed in picking out the wireworms, and the crops of the pheasant are frequently found full of them. I was not aware that the plover or lapwing, called also "pewit," lived very much upon wireworms, until a friend in Norfolk informed me of the fact. In the marshy districts of our eastern counties this bird was formerly exceedingly abundant, as well as the ruff and ree, but the gun and the nest-hunter have so thinned their numbers, that the lapwing is becoming scarce, and the latter have almost abandoned our shores, and, as might be expected, the wireworms seem to be increasing rapidly in such localities. On opening the lapwings that have been shot, their crops were found full of wireworms; and as it is supposed that one bird would eat a hundred in a day, the flocks of forty, fifty, and upwards, that were constantly to be seen some years since would clear off a very large number in a season. Their assistance, however, is departed and gone for ever; for the high price which the eggs fetch in the market cause the peasantry to look so carefully after the nests, that the only chance the lapwing has of escaping destruction is to seek the wildest districts of Scotland and Ireland, where their eggs not being so essential a luxury as they are considered in England,

* *Mag. Nat. Hist.*, vol. vi. p. 142.

they may escape the persecution they have so long endured. Whether the destruction of late years of whole fields of corn at Oxborough, near Stoke in Norfolk, is attributable to the absence of these birds, I cannot say; but it is certain that formerly the plover abounded in that neighbourhood, and now scarcely a pair can be seen.

Before leaving the birds, it may be worth reminding the farmer, that in Norfolk much benefit is derived from turning ducks into fields at the time of ploughing, when they pick up the wireworms, the larvæ of the cockchafer, &c., and whatever slugs there may be; and with regard to the wireworm, we think that turkeys and barn-door fowls would prove equally, if not more serviceable.

There is not the least doubt that in many districts great mischief has arisen from the eternal warfare carried on against the mole, as if it had been created expressly and entirely to do mischief, but hear Mr. Le Keux's praises of this persecuted little animal in Devonshire:—"I think it probable that the mole may prove the best protection against the ravages of this insect; because I observed that seven years ago moles were very numerous all over the farm, and at that time the wireworm was never found to be injurious to any of the crops, but a war of extermination has ever since been most sedulously carried on against the mole, and with such success, that it has become a rare thing to meet with upon the farm. The wireworm, on the contrary, is now (1830) so abundant as to cause very serious and perceptible injury by laying bare large patches in the different crops."*

Frogs, toads, and lizards feed upon insects, but whether they reduce the broods of the wireworm I am not able to determine. It has, however, enemies in the insect tribes, which probably aid very materially in keeping this destructive animal in check.

In the early part of August, a friend sent me a pupa, with the exuviæ, earthen cases, and some wireworms; in one of these, which seemed to be full-grown, I found two or three white maggots, and another had changed into a nympha or chrysalis, from which I could see that it was an hymenopterous insect, which of all the orders contains the greatest number of species that are employed by the Creator to attack noxious and other insects. Concealed therefore as the wireworms are in the earth, and armed with a coat of mail which will withstand most external assaults, this little ichneumon fly† discovers their retreats, and puncturing the sutures of the skin in all probability which are more membranous, deposits her eggs in the body of the worm, to feed upon the muscles, and thus destroy this enemy to the culti-

* *Transactions of the Entomological Society*, vol. ii. p. 31.

† I have since ascertained that it is a *Proctotrupes*.

vator. This discovery I supposed to be perfectly novel as regarded the wireworm, but on turning to Bierkander I find the following statement:— "Nature has, however, furnished allies against this army of vermin, as an ichneumon, by means of its aculeus, or egg tube, if I may so call it, insinuates its eggs into many of them, so that in thirty worms which I have taken, I have found six that have been thus quartered upon. From one of these worms, with the loss of life of the host, six, ten, thirteen, to twenty guests have come out. Which ichneumon this is I have not yet discovered, as the pupæ put into jars have all died."*

The same author† also says:—"The 14th of June, a wireworm drew from its mouth a thread 8 inches in length." This must have been a *Filaria*, of which I find in the *Gardeners' Chronicle*‡ the following notice:— "*W. W.* The thread-like substance 5 inches long, which you extracted from the body of a wireworm, is an intestinal worm, belonging to the genus *Filaria*. Similar worms have been observed in various insects, but still your fact is a very interesting one, showing that the filariæ are found in the larvæ of insects."§ (*S.*)

I believe I may here close the history of the true wireworms most abundant in fields and gardens. I trust that the descriptions and figures will enable the inquiring cultivator to study their economy satisfactorily; and likewise that the mass of information relating to the destruction of them may enable both the farmer and the gardener to encounter more successfully this great enemy to their crops and industry.

In the next chapter I shall give the history of some allied species, as well as those larvæ which are so often confounded with the true wireworms.

SUMMARY OF THE FOREGOING CHAPTER.

Wireworms feed upon corn, turnips, mangel-wurzel, potatoes, grass, cabbages, and garden flowers.

Every *root-worm* has been designated the wireworm by agriculturists.

Great errors circulated in print by persons ignorant of the science of entomology.

Seventy species of beetles inhabiting England, which are the parents of wireworms.

These *elater-beetles* are called spring-beetles, skip-jacks, and snap or click-

* *Communication to Board of Agriculture*, vol. iv. p. 414. † Ibid. p. 415.

‡ Vol. iii. p. 433.

§ I have seen several of these worms issuing from the tails of beetles, principally *Carabidæ*, when thrown into alcohol to be preserved: they were brown and as thick as very stout cotton.

beetles, from the power they have of leaping up when placed on their backs, and the noise they make on such occasions.

Eggs minute, and whether laid in the earth, or in the base of the young wheat-stalks, not determined.

Wireworms almost *invisible* when first hatched: but some, when full-grown, nearly *an inch long.*

They live *five years* in the larva or feeding state.

They *cast their skins* several times, after which they are white, and very tender for a short time.

They resemble the *mealworm*, but are smaller, not so cylindrical, and very different when minutely examined.

They have *small mouths*, with strong jaws, six pectoral feet, and an anal foot.

When full-grown the wireworm forms a *cell in the earth*, in which in moults and becomes a pupa or chrysalis, generally in July or August.

This *pupa* is stationary, quiescent, and harmless.

It changes again to an elater or beetle in *two or three weeks;* at first it is white and tender, but in a short time it gains its proper colour and hardness.

The *beetles run* with their heads down, and drop when approached: they also *fly well*, and are *perfectly harmless*, feeding only on flowers.

The females sometimes have the *ovipositor* or egg-tube exserted.

The *mouth of the elater* differs considerably from that of the wireworm, but consists of the same organs more perfected.

Four species of elaters most common *in corn fields*, which have been reared from the wireworms.

Elater sputator the smallest of these, and variable in colour: found in the spring.

Elater obscurus rather larger, and appears also in the spring.

Elater lineatus supposed by some to be a variety of the foregoing species. It is now by far the most abundant, and is found in spring and summer.

Elater ruficaudis, the largest of the four, and abundant in the spring on nettles.

Scarcely any land free from the wireworm, and but few crops which they will not attack.

Larvæ of crane-flies, the millipedes and centipedes, all called wireworms by farmers.

Wireworms are of *various sizes* and ages at the same time in a field.

It is doubtful if they can *fast long.*

Eggs probably *deposited* in pastures, clover-lays, and fallows, whilst the surface is undisturbed.

Not deposited in turnip and potato fields probably.

One wireworm will *bite* twenty different stalks.

Very hazardous to re-sow where they have destroyed a crop, unless the soil be ploughed repeatedly.

Wireworms cannot propagate or increase their numbers, and the *elaters do not lay eggs* during the six winter months.

Wherever grass will grow the wireworms may be found.

They are most to be dreaded in *dry seasons*, yet they cannot exist without some moisture.

Oats suffer most severely on fresh broken-up land: often ploughed up and re-sown.

Valuable land laid down in *pasture* to avoid their depredations.

Barley crops generally injured in dry and cold springs.

The elaters and wireworms found *under stones* on downs, whilst the crops were attacked by the latter.

Wheat greatly injured by the wireworms during the whole of winter, it is said.

They descend deep into the earth when *frosts* are severe.

Wheat obliged to be *ploughed up* near Belfast from their attacks.

Affected plants are known by the dying off of the outer leaves.

The wireworms eat into the stem above the roots, and sometimes separate the stalk.

Elaters placed on the earth *buried themselves*, and were found dead at the roots of the wheat.

Elater lineatus abundant beginning of June, but by the middle of the month they had disappeared.

Wireworms form burrows in the earth at 2 or 3 inches deep.

The smallest wireworms often the offspring of *Elater obscurus* and *E. lineatus*, and the largest of *E. ruficaudis*, it is supposed.

Potatoes are destroyed in the west of England, and *escape* the attacks of the wireworms in the eastern counties.

Wireworms found in the *hearts of potatoes* in Dorsetshire.

They destroy the "*sets*" when first planted; to palliate this evil, plant whole potatoes.

It is doubtful whether the *curl* be produced by the wireworm.

Hop plants attacked by them.

Cabbages destroyed by them to a great extent.

Turnips suffer most amongst green crops.

In mild winters the wireworms are found at their roots.

They do most mischief to the *young turnip plants*.

Multitudes of various sizes in August gnawing the young turnip-roots, and biting the extremities off.

Some got into the shell of a *snail*, and ate up the animal.

They will feed upon the *turnip-leaves;* drawing the remainder of the plant afterwards into the earth.

Gardens suffer exceedingly; *lettuces* often fall a sacrifice to the wireworm.

Elater sputator is only fourteen days in the pupa state.

The earth should be scraped away from *infested lettuces*, the worms may then be removed, and the earth returned to the roots.

Hemlock, fool's-parsley, &c., to be eradicated, as the elaters resort to the flowers.

Gardens formed out of a pasture-ground greatly infested by wireworms, and the annuals all destroyed; they eat into the stems of carnations, &c.

In adding *loam* and other soils to garden borders, great care should be taken to free them from wireworms.

On *light lands* they do most mischief from the beginning of March to June. Wheat and white turnips suffered most; rye does not escape.

Barley drilled in at 3 inches becomes sickly, but does well at 1½ inch.

Wireworms, probably, *cannot live* so near the *surface* in a sandy soil.

Lower parts of fields bordering on marshes most infested.

Ryegrass most dangerous with clover for encouraging the wireworm.

Gravelly and sandy soils most infested; *strong loam and clay* most free from them.

They inhabit every *aspect*.

A wet season may not destroy the wireworms, but it does not suit the elaters, which cannot then deposit their eggs.

Paring and burning common land, broken up, preserves the turnip crops.

Wheat sown in *dry weather* most likely to suffer.

Turnips when three or four weeks old attacked the most in some places; but eating through the *tap-root* does not kill the plant.

Crops after clover-lays exposed to the sun, if fed off short, suffer greatly.

By constantly *disturbing insects*, it is probable they may be driven from a locality.

Difference of *soil or season* may cause the failure of a *remedy* which has succeeded elsewhere.

A summer fallow and *burning* the rubbish recommended after clover and grasses; it kills the eggs and starves the wireworms.

Soot and lime will kill them.

Fallows must be kept very clean from *couch* and other grasses and weeds.

Nothing more dangerous than to leave *strips and patches of grass* or lays in ploughed fields.

Waste and wood lands harbour wireworms.

Two crops in succession stock the land with them, especially potatoes.

Two inches of the turf taken off pasture-land by a *breast-plough* an excellent process to secure the succeeding crop: shallow ploughing is supposed to kill the roots.

Feeding land close with sheep will prevent the eggs being laid.

Folding oxen and sheep in the spring may also keep the beetles from coming out of the earth.

Harrowing and hard rolling in March and April strongly recommended.

Top-dressings of lime useful before rolling.

Woad will expel the wireworms.

White mustard-seed equally efficacious; it is supposed they cannot eat the acrid roots.

Mowing corn considered good for getting rid of the wireworms in Germany.

Amongst the leaves of *sweet gale* the wireworms died in two hours; it is serviceable, therefore, if mixed with manure.

They *lived four days in water,* and drowning them by flooding very difficult.

Rape-cake powdered and sown on a field will preserve the wheat crop.

Spirits of tar and sand mixed with the soil will protect a crop.

Refuse lime of gas-works will banish the wireworm.

Chloride of lime-water kills them.

Nitrate of soda will destroy them.

Salt on light sandy soils highly efficacious.

Alcohol will deprive them of life in five minutes, and *turpentine* instantly.

The best *bait* in a flower garden is *sliced potato* stuck down.

Pieces of turnip, cabbage, beet-root, parsnip, carrot, and apple, will also attract them.

Hand-picking a most certain remedy.

Rooks invaluable in catching wireworms, consuming immense quantities.

Wagtails, robins, blackbirds, thrushes, and many small birds, will feed upon them.

Pheasants and partridges very useful in clearing turnips of them.

Lapwings attack them in low grounds.

Ducks, turkeys, and fowls will pick them up in ploughed fields.

Moles feed almost entirely on insects, and are incessantly labouring to find the wireworms and other subterranean larvæ.

Frogs, toads, and lizards feed on insects.

Wireworms are infested by the parasitic larvæ of an *ichneumon*.

A species of *worm* also lives in their bodies.

EXPLANATION OF PLATE F.

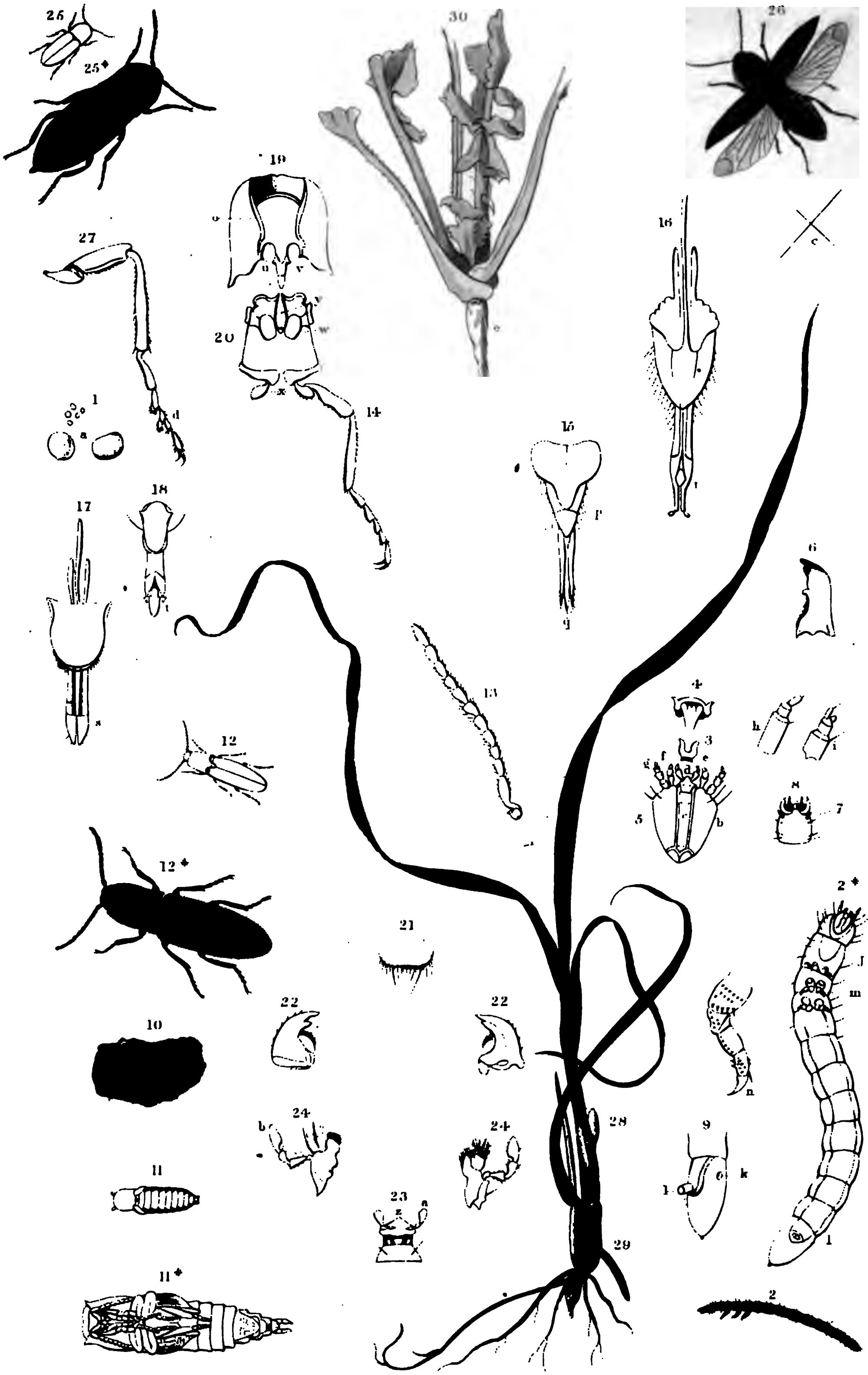
Fig. 1. Eggs of *Elater obscurus*.
*a**, The same magnified.
Fig. 2. The true wireworm or larva of *Elater lineatus* or *E. ruficaudis*?
Fig. 2*. The under side greatly magnified.
*j**, The first thoracic segment.
*l**, The proleg or false foot.
*m**, The three pairs of pectoral legs.
*n**, One of the legs greatly magnified to show the spines and claw.
Fig. 3*. The labrum or upper lip of the wireworm.
Fig. 4*. The clypeus or nose of the wireworm.
Fig. 5*. A large space under the head, formed by the union of the bases of the maxillæ and labium.
*b**, Base of maxillæ.
*c**, The mentum or chin.
*d**, The labium or under lip.
*e**, The labial palpi or feelers.
*f**, The large maxillary lobe, the smaller one below it.
*g**, The maxillary palpus or feeler.
Fig. 6*. One of the mandibles or jaws.
Fig. 7*. One of the minute antennæ or horns.
*h**, A horn greatly magnified.
*i**, Another horn, with an extra lobe.
Fig. 8*. Upper side of the head, showing the position of the jaws, mouth, and two minute dots like eyes.
Fig. 9*. Terminal segments of abdomen.
*k**, One of the large spiracles.
*l**, The proleg or false foot, and vent?
Fig. 10. The earthen case formed by the wireworm to contain and protect the chrysalis.
Fig. 11. The upper side of the pupa or chrysalis removed from the case.
Fig. 11*. Under side of the same.
Fig. 12. *Elater (Athöus) ruficaudis*.
Fig. 12*. The same magnified.
Fig. 13*. The antenna or horn of *Elater obscurus*.
Fig. 14*. Hind-leg of ditto.
Fig. 15*. Male organs of generation of *Elater pectinicornis*.
*p**, Apical segment of abdomen.
*q**, Central instrument.
Fig. 16*. Female organs of generation or ovipositor in the same species.
*r**, The external lobes inclosing the oviduct.
Fig. 17*. Apical abdominal segment and female organs of generation of *Elater obscurus*.
*s**, The two horny lobes uniting and inclosing the oviduct.
Fig. 18*. Male organs of generation in the same species.
*t**, The central instrument.

Fig. 19*. The under side of thorax of *Elater obscurus.*
*o**, One of the grooves for receiving the antennæ in repose.
*u**, Cavities receiving the first pair of legs.
*v**, Spine employed in leaping.
Fig. 20*. Postpectus, with one of the hinder legs attached.
*w**, Cavities receiving the second pair of legs.
*x**, Coxæ or hips, to which the third pair of legs is attached.
*y**, The cavity into which the spine *v* fits.
Fig. 21*. Labrum or upper lip of the beetle called *Elater obscurus.*
Fig. 22*. Mandibles or jaws of *Elater obscurus.*
Fig. 23*. Mentum or chin of *Elater obscurus.*
*z**, Labium or under lip.
a*, Palpi or feelers.
Fig. 24*. Maxillæ, with their hairy lobes.
b*, Palpi or feelers.
Fig. 25. *Elater* (*Agriotes*) *obscurus*, in outline.
Fig. 25*. The same magnified and shaded.
Fig. 26*. *Elater lineatus* represented flying.
c, The natural dimensions.
Fig. 27*. Hind-leg of *Elater ruficaudis.*
d*, The tarsus or foot, showing the fourth minute joint.
Fig. 28. A young wheat plant; the dotted line denoting the surface of the soil.
Fig. 29. A small wireworm feeding in the base of the stem in the earth.
Fig. 30. A young turnip plant, with its roots bitten off by the wireworms.
e, A portion near the base gnawed by them.

All the figures are drawn from nature; and the foregoing numbers and letters with a * attached indicate that the objects referred to are represented much larger than life.

WHEAT AND TURNIP CROPS.

Wire worms and the Click Beetles they produce



CHAPTER VII.

THE NATURAL HISTORY AND ECONOMY OF THE ANIMALS CALLED WIREWORMS, SOME OF WHICH AFFECT THE TURNIPS, CORN CROPS, ETC.

THE history of the true wireworms was concluded in the last chapter, but I am inclined to believe that some of the following insects, belonging to the same family, may contribute, in their larva state, to the injury of the field and garden; and, as they are constantly found in corn-fields in the beetle state, figures and descriptions of them cannot be unacceptable to the farmer; these I shall therefore now lay before him, hoping that they may lead to a more perfect knowledge of their economy. I shall afterwards proceed to give an account of the other animals which appear to assist, with the larvæ of the elaters, in the destruction of the crops, by attacking the roots of the turnips, &c.; all of which have been incorrectly denominated wireworms by the cultivator.

ORDER COLEOPTERA, FAMILY ELATERIDÆ.

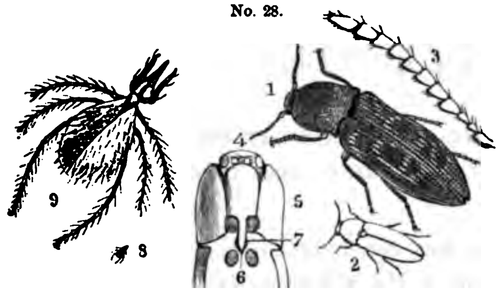
No. 5 is an elater which I frequently observe in corn fields; I find it also under stones: I have taken it off birch trees in woods, &c. Its appearance lasts from the end of April until August, but nothing is known of its economy, or of the wireworm which it produces. It is called—

Elater (Lepidotus) holosericeus, Fab.*—the Satin-coated Click-beetle.—It is elliptical or boat-shaped, deep brown, thickly and minutely punctured, and clouded with silky, ochreous pubescence: antennæ scarcely so long as the head and thorax, slightly pubescent, eleven-jointed; basal joint the stoutest, somewhat chopper-shaped, and chestnut-coloured; second, minute; third, long and slender, clavate; fourth and six following produced internally, obtrigonate, apical joint elongate-ovate, apex narrowed (Plate G, fig. *a;* and No. 28, fig. 3); head small (No. 28, fig. 4); palpi and eyes black; thorax convex, semi-ovate, concave before, broadest at the base, which is bi-sinuated, the angles produced, each forming a strong trigonal lobe, not very acute; pectoral lobe rather

* See Curtis's *British Entomology*, fol. and Plate 694, for dissections, &c., of the *Elateridæ;* and the *Guide*, Genus 309, for an arrangement of the species.

small and tapering (No. 28, fig. 7*); scutel large and orbicular; elytra more than twice as long as the thorax, and scarcely broader at the middle, the ochreous pubescence often forming two ocelli on the disk; nine punctured striæ on each elytron, most distinct at the base; costa emarginate towards the base; wings ample; legs short, slender, and pale ferruginous; length, 5 lines; breadth, 2 lines (Plate G, fig. 31, and No. 28, fig. 1; 2, the natural size).

No. 28.



6. This elater is found in corn fields, and in sandy places, at the same periods as the foregoing species; but whether its larva, or wire-worm, is injurious to the crops, I am unable to state; it is named—

Elater (*Agrypnus*) *murinus*, Linn.—the Mouse-coloured Click-beetle.—It is rather broad and boat-shaped, entirely clothed with very short ash-coloured depressed hairs, marbled with brown, more or less ochreous, and is thickly and minutely punctured: antennæ shorter than the thorax, rather stout, and eleven-jointed, bright ferruginous; basal joint stout, oblong, and piceous, second, small, semi-ovate; third, smaller, pear-shaped; fourth and six following compressed, produced internally, obtrigonate, apical joint longer, ovate, the apex suddenly narrowed (fig. *b*); head semi-orbicular, depressed; eyes scarcely visible; thorax twice as broad, orbicular, convex on the back, with two tubercles on the disk; beneath are two deep fissures to receive the antennæ, and the pectoral spine is long and attenuated, the apex subulate; scutel ovate-conic; elytra a little broader than the thorax, and more than twice as long, hinder portion attenuated, the apex rounded, sloped suddenly towards the thorax at the base; there are nine indistinctly punctured striæ on each, and the costal margin is deeply emarginate to receive the hinder thighs; wings ample; legs short and shining pitchy; the tips of the thighs and the tarsi fulvous—the latter are five-jointed and tapering, basal joint the stoutest and the longest in the hinder pair; claws moderate and acute; tibiæ rough, with series of minute bristles; length, 6 lines; breadth, 2½ lines; sometimes much larger (fig. 32).

7. This species of click-beetle is sometimes abundant in corn fields, also in hedges and grassy places, in May and two succeeding months; but as the

* Fig. 6 exhibits the base of the body, or postpectus, with four cavities, in which the legs were inserted: this, as well as figs. 4, 5, and 7, are given to show the structure of the leaping apparatus, &c., of the under side.

wireworm lives in decaying trees, it is not likely to do any mischief to the crops. It is named—

Elater (Melanotus) fulvipes, Herbst—the Tawny-legged Click-beetle.—It is also called by Marsham, *E. castanipes*—a more appropriate name, as its legs are of a chestnut colour. It is very long, narrow, and shining black, thickly punctured, and clothed with very short, fine, ochreous pubescence; antennæ as long as the thorax, compressed, pubescent, fulvous, and eleven-jointed; basal joint stout and subpyriform; second, minute, nearly globose; third, small obovate; fourth and six following produced internally, obtrigonate, but slightly decreasing in diameter to the apical joint, which is spindle-shaped (fig. *c*); mouth pale ferruginous, the labrum and tips of mandibles piceous; head rather broad, semi-orbicular; the eyes hemispherical; clypeus forming a sharp projecting shelf over the mouth; thorax convex, somewhat semi-ovate, almost straight before, the base nearly straight also, the angles forming rather narrow lobes, appearing pointed above, but truncated laterally; there is a dorsal impression, broadest at the base, and a short longitudinal channel on each side, close to the lobes; the pectoral spine is rather long and narrow; scutel tongue-shaped; elytra thrice as long as the thorax, but not broader, linear, the apex subovate, they are more finely punctured than the thorax, and there are nine punctured striæ on each; costal margin gently hollowed towards the base; wings ample; legs moderately long, chestnut-coloured; tarsi tapering, basal joint the stoutest, and a little elongated; fourth small; claws minute; length from 6 to 9 lines; breadth from $1\frac{3}{4}$ to $2\frac{2}{3}$ lines (fig. 33).

8 Is nearly allied to the *Elater obscurus*, Plate F, fig. 25, but it is smaller. The wireworm of this species is said to abound in grass fields, where it feeds with those of *E. obscurus* and *E. lineatus*; the perfect insects are occasionally found in multitudes in marshy districts in the *rejectamenta* left by floods in Norfolk, Cambridgeshire, &c., and in the spring and summer months they are abundant everywhere. This has been called, I know not why—

Elater (Agriotes) sputator,* Linn.—the Spitting Click-beetle.—It is reddish brown, clothed with short, depressed, ochreous pubescence; antennæ scarcely so long as the thorax, compressed, pubescent; basal joint stout; second rather longer than the third, which is oval, the remainder short and obovate, terminal joint elongated; apex conical; head and thorax black, shining, and thickly punctured; the anterior margin of the latter, and the hinder lobes, reddish brown; the head is somewhat orbicular; the clypeus narrowed; thorax longer than broad, narrow, oblong, very convex, with a dorsal impression behind, the posterior angles forming truncated lobes; scutel oval, truncated at the base; elytra not broader than the thorax, and twice as long, nearly linear,

* See Chapter vi. p. 158.

the apex ovate; they are somewhat scabrose, with nine striæ on each, not neatly punctured, and deepest at the base, costal margin very concave towards the base; wings ample; under side castaneous brown, the angles of the thorax and the pectoral spine, which is rather long and slender, ferruginous; legs moderate, slender; feet tapering, basal joint a little elongated; claws slender; length, 3 lines; breadth, 1 line (fig. 34). The colour of this insect varies considerably, some specimens being entirely bright ochreous, whilst others have the head and thorax partially variegated with black.

9 Is a click-beetle, very abundant in corn fields, hedges, and meadows, in May and June. I have copied the tail of the wireworm from Bouché (fig. 41), who asserts that it lives two years in rotten horse-dung in a high state of decomposition, when it is almost become earthy, and with it the wireworms are of course conveyed into the fields and gardens. The beetle is called—

Elater (*Athöus*) *niger*, Linn.—the Black Click-beetle.—It is boat-shaped, shining black, finely punctured, and clothed with yellowish pubescence, which is not depressed; antennæ longer than the thorax, compressed, tapering, and hairy; basal joint stout; second, minute, ovate; third, obtrigonate; the following similar but larger, produced on the inside, but decreasing towards the apical joint, which is fusiform (fig. *d*); head suborbicular, the clypeus forming a projection over the trophi; thorax twice as broad, oval, very convex, the posterior angles not acute, a little divaricating; pectoral lobe not long and tapering; scutel ovate-trigonate; elytra broader than the thorax, elliptical, the apex ovate or subconical, with nine punctured striæ on each, most distinct at the base; wings ample; legs not long; thighs stoutish, three basal joints of tarsi cushioned beneath; second and third, dilated; fourth, minute; fifth, slender; claws small; length, 5½ to 6 lines; breadth, 1¾ to 2 lines (fig. 35).

10. Abundant in June, July, and August, upon oaks and alders in woods, and not unfrequent in corn fields, but nothing is known of its economy. It has received the name of—

Elater (*Dolopius*) *marginatus*, Linn.—the Margined Click-beetle, and is the *E. suturalis* of Marsham.—It is narrow and elliptical, shining, testaceous, and clothed with short, ochreous pubescence; antennæ longer than the head and thorax, slender, compressed, fulvous, and pubescent; basal joint the stoutest, clavate; second and third the slenderest, elongated—the latter a little the shortest; fourth and following stouter and clavate; terminal joint subfusiform (fig. *e*); head and thorax thickly and strongly punctured—the former obtuse, convex, and pitchy, the latter longer than broad, very convex, piceous, anterior and posterior margins bright ochreous, including the angles, which are very acute and slightly divaricating; scutel subovate; elytra linear, thrice as long as the thorax, sometimes rather broader, attenuated or ovate behind, ochreous or reddish brown, with a space down the suture, and sometimes the costal margin brown; they are somewhat scabrose, with nine distinctly punctured striæ on each, the outer margin slightly concave towards the base; wings ample; under side more or less fuscous or castaneous; the pectoral spine long and narrow, but thick; apex of abdomen testaceous; legs moderately long, slender, and pale ferruginous; tarsi, with the terminal joint, the slenderest, basal joint elongated; claws minute; length, 3¼ lines; breadth, ¾ line (fig. 36). An exceedingly variable species in outline and colour, some specimens being broader than others, and the antennæ are apparently stouter in the males; some examples are entirely bright ochreous or chestnut, and others are uniformly of a pitchy colour.

11. This species also frequents corn fields, meadows, hedges, &c., but whether its larva is injurious to the crops has not been ascertained; it is so like the former one (*E. marginatus*) in miniature, that it will be unnecessary to figure it. It is about the size of *E. limbatus* of Linnæus, but the thorax is narrower and less convex, and there is generally a distinct sort of shallow groove down the crown of the head. It is distinguished by the name of—

Elater (*Adrastus*) *acuminatus*, Step.—the Pointed Click-beetle.—It is elliptical, narrow, shining testaceous, and clothed with short ochreous pubescence; head and thorax black, punctured—the former with an impression down the centre, the latter longer than broad; the anterior margin and posterior angles, which are acuminated, are testaceous; antennæ longer than the head and thorax, compressed, castaneous; basal joint elongated, stout; second and third obovate, the latter a little the shortest; fourth and following somewhat obovate, truncate, terminal joint fusiform; scutel dark, oval; elytra nearly thrice as long as the thorax, punctured, testaceous, the suture often dusky, especially near the apex, with nine punctured striæ on each; under side piceous; pectoral spine long and slender; legs ochreous; length, 2 lines; breadth, about ½ line.

12 Also frequents corn fields, hedges, grassy and woody places, from April to August, but its economy is unknown. It is the *Elater* (*Athöus*) *longicollis* of Fabricius, the Long-necked Click-beetle. The *male* is long and narrow, ochreous, and clothed with very short pubescence of the same colour; head and thorax thickly and coarsely punctured, dull black; the anterior margin of the latter, the sides and base, including the angles as well as the clypeus, more or less ferruginous in many examples; this portion of the head is very concave, the margin thickened and slightly reflexed; the antennæ are more than half the length of the body, slender, and compressed; the basal joint is clavate, and not stouter than the following, which are elongate-clavate and truncated, excepting the second, which is minute, and the terminal joint, which is subfusiform (fig. *f*); the head is subquadrate; the eyes very prominent;

thorax long and narrow, not much broader than the head before, gradually and slightly increasing in diameter to the base; the angles short and truncated laterally; the sides are nearly straight, but slightly convex near the middle; down the back is a faint channel, with a slight fovea on each side near the base; pectoral spine long and slender; scutel small, black, and punctured; elytra more than twice as long as the thorax, and a little broader, linear, the apex ovate, the costal margin fuscous and very gently concave near the base; they are slightly glossy, a little rugose, with nine distinctly punctured striæ on each; wings ample; under side more or less piceous, excepting the body, which is ochreous and very glossy, sometimes pitchy down the centre, or having two fuscous spots on each segment; legs longish, slender, and deep ochreous; tarsi tapering, basal joint elongated; fourth, minute; length, 4¼ lines; breadth rather more than 1 line (fig. 38). The *female* differs so considerably from the male in form, that the name of *longicollis* is not appropriate; it is much broader and larger, the antennæ are not so long, the third and following joints being obtrigonate; this sex varies also greatly in colour, some specimens being entirely brown, others of an ochreous chestnut, &c.

As the wireworms seem to be easily distinguished from each other by the apical segment of the abdomen, I have copied from Bouché* those which he has described, hoping it may tend to their being accurately identified with their respective click-beetles by some one who may be fortunate enough to rear them hereafter. Fig. 41 he calls the wireworm of *Elater niger* (see fig. 35); 42 is *Elater lineatus;* 43, *Elater fulvipes* (see fig. 33); and 44, *Elater fulvipennis.* I must, however, observe, that I have some doubt of his figure of *E. niger* belonging to that species; but the wireworm of *E. lineatus* he has certainly mistaken, as will be seen by referring to our Plate F, fig. 9,† which represents the same portion of the wireworm as fig. 42, Plate G. Bouché's figure of *E. fulvipes* approaches that which I believe to be the wireworm of that insect; and as his drawings are not accurate, I fear, it is most probable they are identical. His *Elater fulvipennis* is most probably correctly named, as it lives in decayed timber, in which it changes to a beetle with yellowish or reddish elytra: his figure represents the under side with the anal foot contracted. I have found, at different times, the wireworms of two allied species, namely, *E. sanguineus*, Linn., and *E. rufipennis*, Hoff., whose habits are similar, and their figure very like Bouché's.

* *Naturgeschichte der Insecten*, Plate 8, figs. 31–34.

† Whether this be the wireworm of *Elater ruficaudis*, or of *E. lineatus*, I cannot positively decide, for they seem to be so exceedingly similar, that it is impossible to detect the slightest difference between any of the specimens I have found at the roots of the turnips and corn crops, or amongst the multitude of examples which have been transmitted to me for my inspection; yet I think the largest specimen must belong to *E. ruficaudis*.

At fig. 39 I have drawn a wireworm, which I believe to be the larva of *Elater fulvipes* (fig. 33); it is very shining, nearly as large as the figure, of a ferruginous colour, with a few long hairs distributed over the body, and a channel down the back; the head is flattened, with four channels in front (fig. *g*), and the tail is conical, concave above, with four channels at the base, rugose and transversely striated towards the tip, which is acuminated, forming a tooth, with two obscure tubercles on each side (fig. *h*); the jaws are black, the six pectoral legs small, and the anal foot distinct.

This wireworm cannot, I imagine, be injurious to the cultivator, as it feeds in decaying trees, from which I have cut it out, together with the perfect insect. Bouché says it lives two years in soft willow wood, and becomes a pupa there in winter.

Fig. 40, I think, may prove to be the wireworm of *E. murinus* (fig. 32), or of *Elater niger* (fig. 35). It does not, however, agree with Bouché's figure of *E. niger* (fig. 41), but whether he be correct I cannot determine. I have thought it necessary to give a drawing of it, having received specimens with other wireworms from Surrey in August; and I have met with the same species under stones, occasionally, on grassy downs. It is very shining, ochreous, and clothed with longer hairs than usual, with a faint channel down the back; the head, first thoracic segment, and tail are ferruginous; it is not so cylindrical as the common wireworm; the head is broad and flattened; the jaws are longish, arched, acute, and black (fig. *i*); the first thoracic segment is narrowed behind; the apical segment is somewhat semi-ovate, with a large oval excavation, forming a hollow above; it is rugose, with two longitudinal channels; the sides are denticulated, and at the apex are two large teeth, generally notched, and separated by a triangular fissure; the under side is tuberculated, and the anal foot is large and broad, with a short horny spine on each side (fig. *k*); the six pectoral feet are small, but serrated beneath with spines, and terminated by simple claws.

We have seen, in the foregoing chapters, that many insects prey upon one another, and that probably no species injurious to agriculture is free from the attacks of parasitic and predaceous insects, which, by subsisting upon the mischievous multitudes, subdue their numbers and render a most essential service to man. I have already alluded to those which live upon the wireworms in the previous chapter; but as I have now obtained additional materials, and am enabled to add figures of the insects which destroy them, as well as others which infest the click-beetles, I shall describe these valuable little friends of the cultivator.

Thousands of insects, called *Carabidæ*, varying greatly in size, from half a line to an inch in length, may be found under stones and clods, in fields, meadows, and gardens, where they secrete themselves by day, and sally forth at night to feed upon other insects, worms, larvæ, &c., which come to the surface at that period, either to feed or to migrate; they are consequently eminently serviceable in reducing the ranks of noxious animals. During a drought they retire into cracks in the earth, and to the most humid spots, and evidently enjoy the refreshing rains which succeed. I have seen the large *Carabus glabratus** in mountainous districts running about immediately after a thunder-storm, each having a tolerably large earth-worm in its mouth; others, as the splendid *Calosoma sycophanta,*† live entirely upon caterpillars in trees; and there is one which well deserves notice from its feeding upon the wireworms—a fact for which I am indebted to a most zealous naturalist, Mr. Marshall Fisher of Ely. The insect alluded to belongs to the order COLEOPTERA, the family CARABIDÆ, and the genus CARABUS of Linnæus, but it has been designated by a new generic name by Megerlé, and is now called—

13. *Steropus madidus*, Fab. (fig. 45), from its inhabiting wet and damp localities. It is shining black; the legs are often red; head oval, forming a neck behind; the eyes are not large, but prominent and hemispherical; the mouth is complete, and furnished with two pairs of longish jointed palpi of a chestnut colour, and two large curved and acute jaws;‡ antennæ not longer than the thorax, tapering, the apex sometimes of an orange colour; thorax broader than the head, somewhat obovate, concave before, truncated at the base, the angles rounded, with a large fovea on each, marked with two short longitudinal channels, and a sharp indented dorsal furrow; the entire surface is delicately striated with transverse wavy lines, which are only visible under a magnifier; the scutel is short and broad; the elytra are convex and soldered together, and consequently both sexes are destitute of wings; their form is oval, narrowed at the base, each having nine deep striæ, the first furcate next the scutel, the eighth impressed with strong punctures, the costal edge a little emarginated on each side towards the tip; legs strong, thighs stout; anterior tibiæ the thickest, with a notch on the inside producing a spine, and another at the apex; the others are spiny, with bristles, and terminated by a pair of moveable spurs; the tarsi are five-jointed, and furnished with two sharp claws; in the male the first pair of feet are dilated and cushioned beneath, the three basal joints being broad and heart-shaped, the fourth similar but minute; length, 7 lines; breadth, 2½ lines.

S. madidus is a very active insect; it prowls about at night, and is admirably adapted to its predaceous mode of life. The free motion of its neck and

* Donovan's *British Insects*, v. 15, Plate 506. † Curtis's *Brit. Ent.*, fol. and Plate 330.

‡ See Curtis's *Brit. Ent.*, Plate 171, for dissections, &c.

thorax gives it an advantage over most insects of its own size, and its strong legs are furnished with spurs and spines, which enable it to stand firmly, and resist the efforts of any individual endeavouring to escape from its grasp. The sensitive horns are in constant motion; with its long palpi it embraces its victim, whilst it tears it in pieces with its sharp and powerful jaws. When touched, these beetles eject a terribly fetid and dirty fluid from the mouth, which is probably a defence against the more powerful and kindred species. To show the usefulness of this insect, I cannot do better than give Mr. Fisher's own statement of the facts which came under his observation. He says, "My brother Henry, seeing a field which had been sown with oats much injured, pulled up several plants, and found numerous wireworms at the roots of each. He put them into a box with several black beetles of the family *Carabidæ,* which he detected in the same field, and on opening it a short time after, he saw one of the beetles with a wireworm in its mouth. Profiting by this accidental discovery, I placed two of the beetles under a glass with a wireworm; the beetles appeared to whet their mandibles, ready for the attack, and in an instant each had seized the wireworm, the writhings of which threw the beetles upon their backs; they quickly recovered their legs, and the worm was soon divided, each taking his share, and entirely sucking out the milky contents, leaving only small fragments of the horny skin. I then introduced several more worms under the glass, and they as speedily disappeared. I repeated the experiment several times with the same results; I therefore think I may fairly conclude that this beetle is a natural enemy of the wireworm."

I can also add the interesting history and economy of another ground beetle, which were communicated to me by Mr. F. J. Graham. It inhabits turnip fields, and is named—

13*. *Nebria* (*Helobia**) *brevicollis*, Fab. This beetle, which is abundant under stones, is depressed and black; the palpi eleven-jointed; antennæ, shanks, and feet pitchy red, the head being furnished with strong mandibles; the thorax is short, broader than long, and somewhat heart-shaped; the wing-cases are ovate, long, and broad, with several punctured striæ on each; in the third stria from the suture there are three or four larger impressed punctures, and beneath the elytra are the wings folded for flight; length, 4½ to 6 lines.

Mr. Graham informed me that on the 9th March, 1850, he observed in turnip and corn fields at Cranford, little heaps of earth thrown up from tunnels, and at the depth of an inch and a half he found cells of an oval form, and within them the larva of *H. brevicollis*, which no doubt is carni-

* Curtis's *British Entomology*, fol. and Plate 103.

vorous. On the 11th April, Mr. Graham sent me the pupa which had lately changed to that state; and on the 21st of the same month he bred the beetle. It began to feed on some small caterpillars on the 23d; and on the night of the 24th, ate the whole of a wireworm, excepting the skin of the back; but flies (at least in confinement) seem to be the favourite food of these beetles. I may add, that on opening the cells of the specimens Mr. Graham had kindly forwarded to me, I found one was partly consumed, and the other had produced six specimens of *Proctotrupes viator* (?); thus showing that this parasite keeps in check the wireworms, and also the larvæ of ground beetles.

It is not a little remarkable, that, about the same time, the economy of *H. brevicollis* was discovered and published in the *Annales de la Soc. Ent. de France*,* by M. Blisson, accompanied by an excellent plate exhibiting its economy. These larvæ are pale brownish, very active, with formidable jaws, having six thoracic legs, and a foot at the apex between two long bristles. Nothing has been recorded regarding the food of these larvæ, but in all probability they are more serviceable in the destruction of other insects than the beetle itself.

Fig. 46 represents a dead shrivelled wireworm, of *Elater lineatus*, I believe, which was infested with parasitic larvæ, one of which had become a pupa (fig. *p*), so greatly advanced that in a few days the perfect fly would have been hatched. By some accident this pupa was forced through the skin, and it is evident that it was some species of ichneumon,† for the head (fig. 47, *l*) is distinct enough, and shows the two eyes; the antennæ (fig. *m*) are inclosed, as the whole animal is, in a transparent shroud. Fig. *n* exhibits the thorax, and fig. *o* the legs and jointed feet. I had hoped to breed this insect, but it died, and it must therefore be left for future inquirers to determine the species of this useful little being, which was not unknown to Bierkander, and is very probably far from uncommon. The specimen was sent to me the 1st August, 1841, having been just discovered with other wireworms in Surrey.

The click-beetles themselves are not free from the assaults of minor enemies, which may not actually destroy them, but I imagine they must exhaust and weaken the individuals they attack, so as to render them incapable of fulfilling their functions with energy. Of these animals two very different species have come under my observation, which I will now describe; but it will not be irrelevant to observe that the class Insecta, as it stood in the last century, included crabs, lobsters, spiders, centipedes, &c. Latreille, however, and modern philosophers have very properly divided them into

* See Second Series, vol. vi. p. 73.

† This, there can be little doubt, was a *Proctotrupes*, as was shown in the previous chapter.

three classes;* the first is called CRUSTACEA, the second ARACHNIDES, the third INSECTA. With the first we shall have nothing to do in this volume; the third is distinguished by its pair of genuine antennæ, six thoracic legs, &c., comprising all the insects whose histories we have recorded; and the second will include most of the few remaining animals, which will complete this chapter.

The class ARACHNIDES embraces the millipedes, spiders, lice, mites, ticks, &c. Amongst the last are included the little parasites before us, the first of which belongs to the order ACERA, family RICINÆ or ticks, genus UROPODA of Latreille. The Baron de Geer describes a tick nearly allied to ours under the name of *Acarus vegetans*;† but as that species is attached by the apex of the body and this by the back, I am induced to think it a distinct species, which I shall call—

14. *Uropoda umbilica.*—It is oval, rusty-brown and shining; the upper side horny, shield-shaped, convex and punctured, with longish scattered hairs. From the back, but a little on one side, arises a peduncle (fig. 49, *s*), which is white, transparent, as long as the animal, sometimes gradually increasing to the extremity, which is attached to the elytra of the elater (fig. 48, *r*). It has eight short-jointed legs, more or less clothed with hairs, which in repose are pressed close to the under side; the first pair seem to be somewhat palpiform, and a little the longest, especially in the terminal joint, which is densely hairy at the apex; the second pair are the shortest, similar to the preceding, but tapering, and less hairy; the others are terminated by a slender transparent clavate joint, destitute of hairs (fig. 48, *q*; the natural size).

This curious tick infests the *Elater obscurus* (fig. 48), attaching itself in considerable numbers to the wing-cases, by a singular contrivance in the shape of a thread, which is fixed by one end to the tick, and by the other to the click-beetle. This is probably a provision to prevent the tormented animal from rubbing off his parasites; they are able, according to the remarks of De Geer, to remove when they please, by crawling in a certain direction until the cord is sufficiently strained to cause the end to be detached from the beetle. It has been supposed that these animals obtain their nutriment through this tube; and whether they possess a rostrum for sucking I have not been able to ascertain, from the extreme minuteness and obscurity of the head.

The other parasite belongs to the same order, ACERA,‡ but to the family MICROPHTHIRA, and the genus LEPTUS, Latreille. It infests the click-beetle named *Elater ruficaudis*, which has been already described and figured.§ It

* Dr. Leach formed the insects of Linnæus into five classes, namely, Crustacea, Arachnöida, Acari, Myriapoda, and Insecta.

† *Mémoires pour servir à l'Histoire des Insectes*, v. vii. p. 123, Plate 7, figs. 15 and 16.

‡ Latreille, in his later works, makes this a family only of his *Arachnides*.

§ See Plate F, fig. 12.

is a very different little animal to the *Uropoda umbilica*, thrusting its beak into the punctures of the thorax and elytra of the beetle, and thus absorbs the juices (fig. 50, *t*). The dreadful pest called the harvest-bug,* which insinuates itself into one's legs, causing an insupportable irritation, and which is also red, but invisible, or nearly so, to the naked eye, is closely allied, I believe, to our tick, which appears to be described by De Geer under the name of *Acarus Phalangii*, from its infesting the harvest-spider (*Phalangium Opilio*). It now bears the appellation of—

15. *Leptus Phalangii*.—It is of a brilliant scarlet colour, and soft. The head is pear-shaped, terminating in an attenuated slightly-curved rostrum, and on each side is an appendage forming a pair of horns or short legs; these seem to be tri-articulate, the basal joint the stoutest, third small. The abdomen is large, and like an oval bag, attached by a narrow base, forming a neck. The back and belly are sparingly clothed with black stoutish hairs. To the pectus are attached six long slender legs, remote at their base, especially the hinder pair, which are the longest, and those before them are shorter than the second pair: they are composed of many joints, and clothed with black hairs, which appear thick, from their being pubescent, I suspect: fig. 51; the natural size being shown at *t*, fig. 50, and No. 28, fig. 8; 9, magnified.

Having now discussed every subject, I believe, relating to the "true wireworms," I shall turn to the history of the other animals which are improperly included by agriculturists under that denomination, and may not inaptly be termed "false wireworms." Some of them may be almost as injurious to the crops as those just described; but as portions of their economy still remain doubtful, this is a point which I fear cannot be determined satisfactorily.

A general belief prevails amongst farmers that the larger gnats, or *Tipulæ*, called crane-flies, daddy long-legs, &c., are the parents of the wireworms. This we have already shown to be quite a mistake, yet it is very far from improbable that the maggots of the *Tipula oleracea*, &c., may do mischief to farm as well as to garden crops; but as they are most destructive to grass lands, I shall pass by their history until I arrive at that portion of my work. There is, however, a larva of a fly (*Musca?*) which I shall here describe and figure, as it is an undoubted enemy to the corn crops; and, being one of the false wireworms, it will come under this head. I regret exceedingly that it did not reach my hands in a living state, in order that I might have reared it, to ascertain the parent insect. The larvæ alluded to were found in great numbers in May, 1841, attacking the roots of Lord Prudhoe's wheat, and

* *Leptus autumnalis*, figured in Shaw's *Zoological Miscellany*, vol. ii. Plate 42

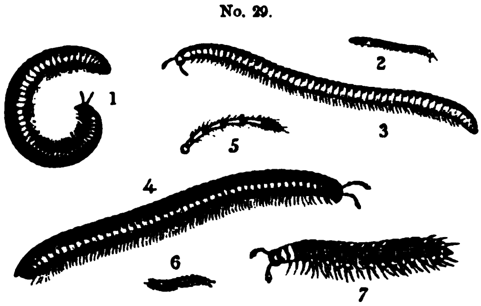
were transmitted to Mr. Yarrell, who gave them eventually to me. They were of a yellow ochreous colour, composed of the usual number of segments (fig. 52), tapering to the head, and truncated at the tail, and were about two lines long (*v*). The head was furnished with two small black horny fangs (*u*); and the tail was cut off abruptly, the lower circumference being deeply indented, and forming several irregular lobes, and in the centre were two brown tubercles (*w*). It was destitute of feet, as such maggots usually are.

I must not omit to mention a gnat, probably the *Tipula maculosa*, which I have bred from larvæ; these no doubt are exceedingly destructive to young plants in turnip and corn fields, where I have seen the gnats in multitudes.

The remaining animals which infest the roots of corn and other crops, and called also wireworms by the farmers, belonged to the class Arachnides and the order Myriapoda. Latreille subsequently altered the value of these terms, changing them to the class MYRIAPODA, the order CHILOGNATHA, and the family ANGUIFORMIA. Linnæus gave them the generic name of JULUS; and from the typical species resembling snakes in miniature, especially the slow-worm, I have applied to them the English appellation of snake-millipedes. After describing them I will relate their history and economy. One has been named—

16. *Julus guttatus* by Fabricius, and *pulchellus* by Leach—the Spotted or Beautiful Snake-millipede. It is now included in the genus BLANIULUS. This species is from one-sixth to half an inch long, or upwards. It is slender, cylindrical, and shining (*x*); it has about 170 legs; the horns are clavate, pubescent, and seven-jointed, the apical joint being minute (*y*); the eyes are black, and coarsely granulated;* it is pale ochreous, with a double row of bright crimson spots down each side, excepting the four first and five last segments; the whole of them are faintly striated longitudinally with a rather deep incision separating the rings (fig. 53, and No. 29, fig. 2; 3, magnified).

No. 29.



After death this species becomes of a fine sanguineous purple, which will stain the paper upon which the specimens are gummed. It is, I think, the most widely spread, if not the most abundant, of the snake-millipedes. It inhabits both fields and gardens, and has been observed feeding upon a small Helix.

* Guerin says they have none; perhaps they are only visible when alive.

17. *Julus Londinensis* of Leach, the London Snake-millipede (fig. 54, and No. 29, fig. 1), is usually about an inch long, cylindrical, shining, and rather stout. It is of a dark lead colour. The segments are longitudinally striated, the margins subferruginous; there are two black dots on each, excepting the five thoracic and four apical ones, forming a line of pores down each side, from which an acid liquor flows, of a disagreeable odour, which is said to be employed to defend itself from enemies. The legs are dirty white, and amount to about 160, in pairs on each side, so that each segment seems to be provided with four legs. The head is brownish, and pubescent, with black granulated eyes. The antennæ are brown, clavate, and a little hairy. The basal joint is subglobose; second elongated, and slightly exceeding the following in length; the third, fourth, and fifth are stouter, ovate-truncate, the last forming a club in union with the sixth, which is small. Thoracic segment twice as long as the others. Apex of abdomen rounded, with a vertical slit; the penultimate ring with the centre a little angulated, and lapping over the apex, but not mucronated (*z*).

This is a large species, and similar to the following; but there are gigantic snake-millipedes in South America, as thick as one's little finger, and upwards of half a foot in length. *Julus Londinensis* was so named from its having been first discovered in the neighbourhood of the metropolis; and it infests the roots of wheat in Surrey, from whence I have received specimens at the end of April, which had not arrived at their full growth.

18. *Julus terrestris*, Linnæus—the Earth Snake-millipede (No. 29, fig. 4, magnified). Shining, cylindrical, and piceous; rather strongly striated longitudinally; the edges of the segments brownish, a line of indistinct black pores on each side; the legs ochreous; eyes black, and granulated; antennæ spotted, longer than the first thoracic segment, which is larger than the others, seven-jointed, basal joint globose, four following elongated, clavate, truncate, the last being the stoutest, and forming with the sixth and seventh a little oval club, the apical joint being minute (b, and No. 29, fig. 5); penultimate segment of abdomen mucronated (a); the lobe subtrigonate, the tip rounded.

This species greatly resembles the foregoing, but the spined tail and longer antennæ readily distinguish it. I remember one being discovered inside a rotten pear.

19. *Julus punctatus*, Leach—the Dotted Snake-millipede—is often an inch long, but rather slender, cylindrical, and of a testaceous brown or ochreous colour; the margins of the segments are finely and very closely striated; the crown of the head and thoracic segment are freckled, the penultimate one is mucronated, the lobe oval; face, antennæ, and legs, pale ochreous; eyes gray,

granulated with black. When alive this species is of a somewhat pellucid pale flesh colour, every segment with a black dot forming a line down each side.

I generally find this julus amongst the moss on old stumps, and under stones in woods; but I think I have received it with the other species from gardens.

20. *Julus latestriatus*, Curtis—the Broad-lined Snake-millipede—is 5 or 6 lines long, of a dull ochreous lilac with a purple tint, cylindrical, very shining, sparingly striated, the lines not approximating; down each side is a row of dots, and the penultimate segment is not mucronated, but slightly angulated and rounded, as in *Julus Londinensis;* the antennæ are stout and rather short, pilose and capitate, second joint the longest, the apex very pubescent.

This julus I took at first for the young of *J. Londinensis*, but the striæ are twice as far apart as in any other species I have examined, and when dead it greatly resembles *J. pulchellus* in colour. I have never seen it alive; but thousands were infesting a garden at Nantwich, and a small box full was forwarded to me.

21. *Julus pilosus*, Newport's MSS.—the Hairy Snake-millipede—is nearly an inch long, rather slender, cylindrical, lead-coloured, slightly pilose, the margins of the segments being striated and somewhat ciliated, the penultimate segment is mucronated; the lobe is pointed, and projects beyond the terminal joint, which is brown and hairy; there is a line of black dots down each side; the thoracic segment, head, and antennæ are brown: these last are rather long, slender, very pubescent, and slightly clavate; the fifth joint is nearly as long as the second.

This very distinct species stands in the British Museum with the above appropriate name, being distinguished from all the others by the hairs scattered over its entire length. I have found it more than once infesting the roots of cabbages in gardens in March.

There is one more species which belongs to the genus POLYDESMUS of Latreille. It is essentially distinguished from the juli by the apparent absence of the eyes, as well as by its flattened back, the segments being a little dilated or margined on the sides, and the hinder angles of each are acute; the tail is mucronated, and it has only between sixty and seventy legs: the antennæ are seven-jointed, the basal joint being subglobose; second, ovate; the third is by far the longest; the two following are elongate, clavate, and truncated; the sixth is stouter and ovate, forming a little club; the seventh is small (d); the species is named—

22. *Polydesmus complanatus*, Linnæus—the Flattened Millipede (fig. 55; and No. 29, figs. 6 and 7).—It is of a pale lilac colour above; the back is

granulated; the belly is whitish; the legs are more or less ochreous. It is generally from ¼ inch to 3½ lines long (c), but when arrived at maturity some specimens are as large as fig. 55.

This is reported to be by far the most destructive species. In April, considerable numbers of the smaller ones were detected eating the roots of wheat, and in the spring and autumn they were injuring the roots of onions and pansies. They propagate rapidly where the earth is undisturbed; and specimens measuring three-quarters of an inch have been found under garden pots at the roots of anemones. In a systematic arrangement *Polydesmus* forms a natural transition from the snake-millipedes to the centipedes, called *Scolopendræ*, the habits of all being similar; but as the numbers of the latter family are comparatively insignificant, and they are said to live like the earth-worms upon the soil alone—which, however, I very much doubt—it will be unnecessary at present to enter further into their economy.

The snake-millipedes seem to be both carnivorous and herbivorous, for they have been detected feeding upon small snails, as well as upon the pupa of a fly; and they are believed to live also upon larvæ, acari, earth-worms, &c.; and there is such abundant evidence of their destroying the roots of many vegetables, being found clustered together in multitudes at the roots of corn, potatoes, turnips, cabbages, &c., that there can be little doubt of their doing great mischief to many crops of the gardener, and apparently to the farmer also. In order to confirm this generally received opinion, which appeared formerly to rest upon doubtful evidence, I shall enumerate the different proofs which have come to my own knowledge.* A garden at Ledbury, Herefordshire, was infested by *Julus pulchellus*, which congregated in masses at the roots of the brassica tribe. On pulling up some rotten cabbage stalks in the beginning of March, I found the *Julus pilosus* amongst the roots; they were then of a large size, and had, as well as I could ascertain, 156 feet, being thirty-nine pairs on each side. At the end of the same month *Julus Londinensis* was detected at the roots of wheat; they were at that time an inch long, and *Julus pulchellus* was observed with them: these I buried at the roots of some potatoes and wheat, which I dug up in August, when the former were completely decayed, but the latter were not in the least injured; and I could not detect any of the snake-millipedes. I received some roots of the scarlet-bean from Ullswater, in Westmoreland, which were eaten through and through by the *Julus pulchellus* and *Polydesmus complanatus*, which were still sticking in the holes formed by them in the cotyledons; and the party who transmitted them stated that thousands

* Latreille says, "These insects (the millipedes) live upon substances both vegetable and animal, but dead and decomposed."—See Cuvier's *Règne Animal*, edition 1829, vol. iv. p. 333.

of those species infested his garden, destroying the pease and kidney-beans also. Near Nantwich, in Cheshire, the *Julus latestriatus* was in countless myriads in January 1844, destroying the potted plants in the green-houses, by eating the rind just at or under the surface of the soil; and cauliflowers and cabbage plants shared the same fate in the garden: nearly at that period of the year the *Julus Londinensis* was doing great injury to the early potato crops near Chester. My friend Mr. W. W. Saunders, who is too able a naturalist to be deceived, has ascertained that the juli are very destructive in his garden at Wandsworth, where they devoured the young shoots of the heart's-ease just below the surface. I have more than once observed the snake-millipedes and polydesmi in September infesting the roots of onions which had been attacked by the maggots of a fly; * and the polydesmus injures the carrot crops by eating various labyrinths in the roots. The juli are also found in pears, apples, &c., but I believe not in sound fruit. A few similar proofs the reader will have observed appended to the descriptions of the various species. These animals are also found in considerable numbers under the loose bark of decaying trees, in company with woodlice, earwigs, &c., also amongst the moss which clothes the base and holes in the trunks and stumps of trees, and likewise under stones in humid situations.

The action of the snake-millipedes is very remarkable; the horns are constantly moving when they walk, which is very leisurely, yet they appear to glide along in a very peculiar manner, owing to the immense number of legs they possess, amounting sometimes to 240: these legs are very small, jointed, and terminate in a single claw, and are so thickly set in pairs, that when the animal is in motion they resemble a fringe of hairs, one pair moving after another in quick succession, yet with the most exact and beautiful regularity, causing an undulatory effect. They are able to jerk themselves about like a scotched snake, and when disturbed they coil themselves up spirally, the head forming the centre, and all the legs are then contracted and concealed, and in this position they appear to repose.

These animals being long-lived have ample means of doing mischief, if such be their nature, for they do not arrive at their full growth until the expiration of two years, when the organs of generation are developed, and during that period they change their skins, or rather horny coats, five times: in this respect they resemble the true wireworms, but there is a great difference in their economy; for these, as we have shown, become beetles, and pass through four distinct stages or metamorphoses, namely, the egg, larva, pupa, and beetle, whereas the snake-millipedes, &c., are animals which seem to be

* Called *Anthomyia ceparum*, Hoffmansegg; see *Gardeners' Chronicle*, vol. i. p. 396.

always in a caterpillar state, undergoing a constant succession of growth, and increasing in bulk from their birth to their death, so that they are active and feeding during the whole period of their lives, and do not, like the true wireworms and other larvæ of insects, ever change to anything else. The females lay their eggs from Christmas until the middle of spring, each depositing a great number in the earth: those of some species are round, whilst others are stated to be oval and of a dirty or yellowish white colour. A few of these animals, however, may be said to undergo certain degrees of perfection as they increase in stature, for they are very dissimilar in their infancy to their parents, having very few legs when they are first hatched,* at which period the young of *Julus sabulosus* have only three pairs, and seven or eight abdominal segments alone, but in four days they acquire four pair more with additional rings. The number of segments thus increasing with the age of the animals, renders a knowledge of the species difficult to acquire, and this is not diminished by the frequent moultings; it is therefore possible that some of the smaller species may be only the younger state of the larger ones, yet I cannot think but that all I have described are quite distinct.

The way in which these animals live amongst the roots of plants, renders it extremely difficult to destroy them, without sacrificing the infected crop; and their horny coats, which resist the point of a pin, being impervious to water, nothing, I should conceive, could be of much service but very great heat and hand-picking; unless, indeed, any dressing could be discovered which is disagreeable to them: whether lime would answer the purpose I have no means of ascertaining, but I am inclined to think it might, for I believe that they cannot endure heat, and I am certain they are not able to exist without humidity, for if confined in a box deprived of moist earth or damp moss they die in a few hours. The following remedies have been suggested by various writers.

Watering the land repeatedly with lime-water is believed to destroy the millipedes, and soot spread over the surface will drive them away. Sprinkling nitrate of soda round the plants, and afterwards watering them, would, it is presumed, prove the best remedy, or watering the land with a solution of the nitrate would be equally beneficial, and more applicable to extensive crops; but this operation must be performed in a dull damp day, or in the morning or evening when the sun does not shine upon the field, otherwise it might scorch the leaves. Mr. Wilshin, of Hayes, near Uxbridge, finds that salt applied to the land before the crops are sown, is an excellent remedy against all sorts of wireworms. Traps should also be resorted to, particularly

* De Geer's *Mémoires*, vol. vii. p. 583, Plate 36, figs. 20–22.

in gardens, where if loosely made baskets, such as strawberry pottles, were filled with damp moss, especially during dry weather, and sunk in the earth, the juli would, in all probability, resort to them, and the baskets might easily be drawn out by the handles every morning, in order to examine their contents and kill the animals. In hand-picking, all large stones and clods should be turned over, as the millipedes secrete themselves in such humid situations, and where these animals are abundant, large numbers, I expect, might be caught by strewing old cabbage-leaves over a field, in the same way as when slugs are troublesome, and employing children to turn them over and collect the millipedes, &c., secreted beneath.

SUMMARY OF THE FOREGOING CHAPTER.

Descriptions of eight *click-beetles* which inhabit corn fields, namely—

Elater holosericeus, the larva or wireworm of which is unknown.

Elater murinus, it has not been ascertained whether the wireworm of this beetle is injurious to the crops.

Elater fulvipes, its wireworm lives in decaying trees.

Elater sputator, the wireworm of this species is very abundant and injurious in meadows and pastures.

Elater niger, the wireworm is said to live in rotten horse-dung.

Elater marginatus, the wireworm of this beetle has not been discovered.

Elater acuminatus, the economy of this wireworm is not known.

Elater longicollis, the wireworm of this species has never been detected, that I am aware of.

Descriptions and habits of the *wireworms* of some of the above and other species of click-beetles.

Some of Bouché's figures of the wireworms appear to be inaccurately named, that of

Elater niger may be correct, but the larva of his

Elater lineatus is certainly the wireworm of some other species.

His *Elater fulvipes* may be intended for that wireworm, and that of his

Elater fulvipennis, inhabiting decayed timber, is probably correctly named.

Elater fulvipes, its larva described, but it is not injurious to the crops; it lives two years in decaying willow-trees.

Elater murinus, or *E. niger*, description of the supposed wireworm of one of those species.

Probably none of the insects injurious to agriculture are free from *parasites*, of the class Insecta.

The *Carabidæ*, eminently serviceable in the destruction of larvæ, worms, &c.; *Carabus glabratus* feeds upon the earth-worm.

Calosoma sycophanta feeds upon caterpillars.

Carabus (*Steropus*) *madidus* destroys and feeds upon the true wireworms.

Nebria brevicollis, another ground-beetle, is bred in turnip fields, and lives upon larvæ, &c.

One of the true wireworms of the "Striped Click-beetle," probably *Elater lineatus*, is inoculated with maggots, which produce *ichneumons*.

The click-beetles are infested with *vermin*, which belong to the class *Arachnides*.

Uropoda umbilica is a tick which attaches itself in considerable numbers to the click-beetle, called *Elater obscurus*.

Leptus phalangii is a tick which infests the *Elater ruficaudis*, the red-tailed click-beetle.

History of the *false wireworms*.

The larva or maggot of the *Tipula oleracea*, one of the crane-flies, is improperly called a wireworm; it is very injurious to pasture lands.

The maggot, apparently of a fly, was abundant in a wheat field, feeding upon the roots.

Tipula maculosa, in multitudes on arable land.

Descriptions of the *snake* and other *millipedes* which infest the roots of plants, and are improperly denominated wireworms.

Julus guttatus or *pulchellus* inhabits both fields and gardens, and is widely spread over England.

Julus Londinensis infests the roots of wheat in April.

Julus terrestris is found in rotten fruit, &c.

Julus punctatus inhabits moss on trees, and resides under stones.

Julus latestriatus, thousands infested a garden and green-house, destroying cabbages and potted plants.

Julus pilosus lives in cabbage roots in March.

Polydesmus complanatus is said to be the most destructive species, eating the roots of wheat and destroying onions and garden flowers.

Snake-millipedes feed upon animal as well as vegetable substances, such as snails and earth-worms; and in addition to the plants already alluded to, potatoes, turnips, the entire tribe of cabbages, beans, pease, carrots, &c., suffer from their attacks.

When the *snake-millipedes* walk they glide along, and curl themselves up spirally when at rest.

They live two years before they can procreate their species, and change their skins five times.

The females lay a great number of minute *eggs* in the earth, from Christmas to the middle of spring.

The *young* when first hatched have only *six legs*, which increase with age until they have from 150 to 240.

Application of artificial *heat* and *hand-picking* the most certain remedies.

They cannot live without *moisture*.

The application of *lime* probably would be serviceable where they abound, especially *lime-water*.

Soot spread over the land will drive them away.

Sowing *nitrate of soda*, or watering the crops with a solution of it, or of common salt, might destroy them.

Dull damp days the best for this operation, and never attempt it when the sun shines upon the crop.

Baskets filled with *damp moss*, and sunk in the earth, might be employed in gardens as traps to decoy them, especially during droughts.

They will be found *under clods* and *stones* in fields, pastures, &c.

Old cabbage leaves, if strewed over fields, would *attract* them, where they are numerous and hand-picking is resorted to.

EXPLANATION OF PLATE G.

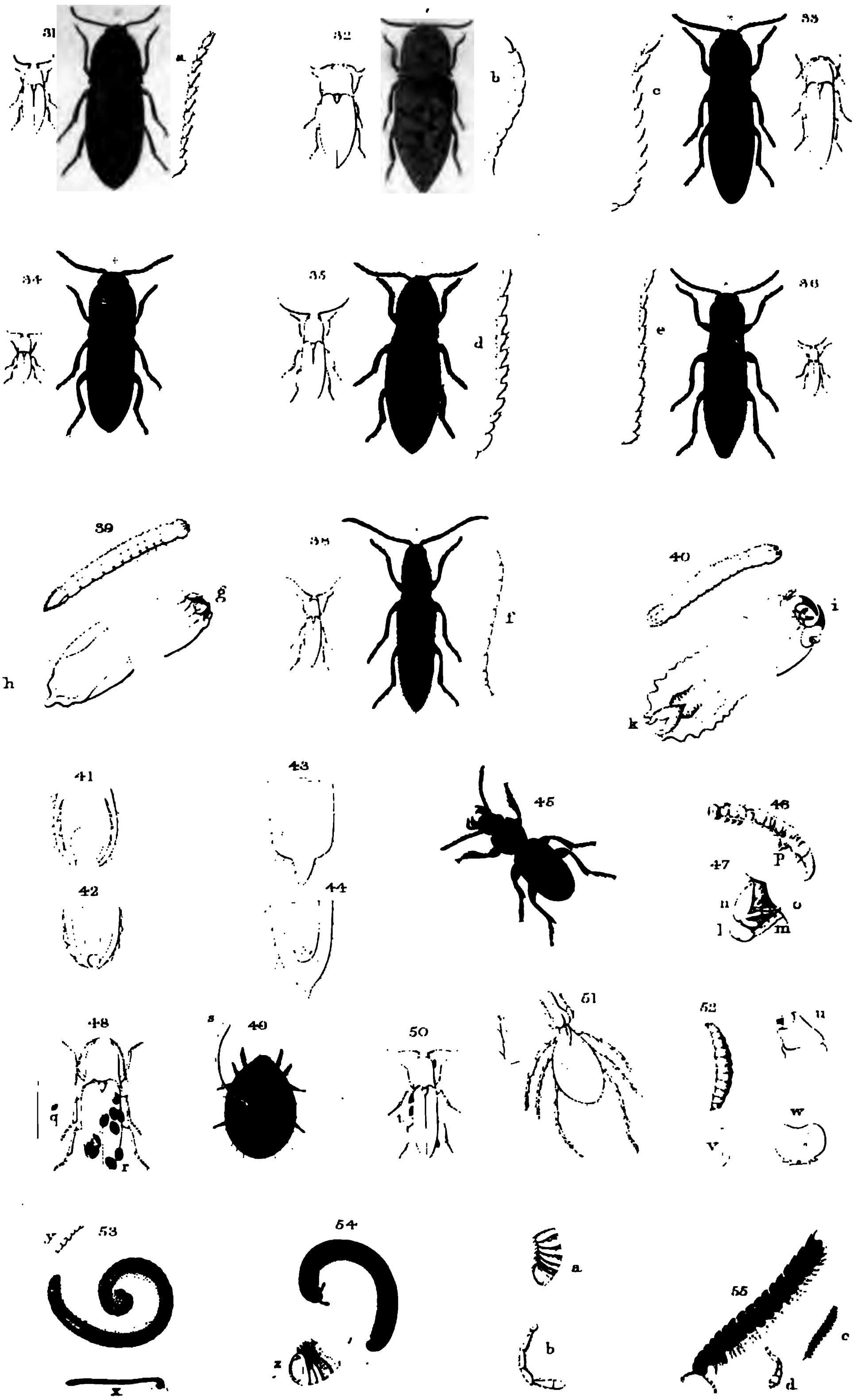
Fig. 31. *Elater holosericeus.*
*, The same magnified.
*a**, The antenna or horn.
Fig. 32. *Elater murinus.*
*. The same magnified.
*b**, The antenna.
Fig. 33. *Elater fulvipes.*
*, The same magnified.
*c**, The antenna.
Fig. 34. *Elater sputator.*
*, The same magnified.
Fig. 35. *Elater niger.*
*, The same magnified.
*d**, The antenna.
Fig. 36. *Elater marginatus.*
*, The same magnified.
*e**, The antenna.
Fig. 38. *Elater longicollis* ♂.
*, The same magnified.
*f**, The antenna.
Fig. 39. Wireworm of *Elater fulvipes?*
*g**, The head.
*h**, The tail.
Fig. 40. Wireworm of *Elater murinus?*
*i**, The head.
*k**, The tail.
Fig. 41.* Apical joint of the wireworm of *Elater niger?*
Fig. 42.* Do. do. called *Elater lineatus* by Bouché.
Fig. 43.* Do. do. *Elater fulvipes?*

Fig. 44.* Apical joint of the wireworm called *Elater fulvipennis.*
Fig. 45.* *Steropus madidus* ♂.
Fig. 46. Emaciated wireworm of *Elater lineatus?*
p*, The pupa protruded.
Fig. 47.* The same pupa magnified.
l*, The head and eyes.
m*, The antennæ.
n*, The thorax.
o*, The feet.
Fig. 48.* *Elater obscurus.* The line shows the natural length.
r, The tick with which it is infested.
q, The natural size of the tick.
Fig. 49.* *Uropoda umbilicus,* removed from the click-beetle.
s, The cord by which the animal is attached.
Fig. 50. *Elater ruficaudis.*
t, The parasitic ticks, called *Leptus phalangii?*
Fig. 51.* The same tick removed, and greatly magnified.
Fig. 52.* Larva of some *Tipula?*
v, The natural size.
u*, The head in profile.
w*, Front view of the tail.
Fig. 53.* *Julus guttatus* or *pulchellus.*
x, The natural size and walking.
y*, The antenna.
Fig. 54. *Julus Londinensis.*
z*, The unarmed tail.
a*, The armed tail of *Julus terrestris.*
b*, The antenna of the same species.
Fig. 55. *Polydesmus complanatus* when full grown.
c, The younger state.
d*, The antenna magnified.

All the figures are drawn from nature, and those numbers and letters with a * attached indicate that the objects referred to are represented much larger than life.

ARABLE AND PASTURE LANDS.

Click-Beetles, Wire Worms, false Wire Worms &c. infesting arable and pasture lands



J. Curtis

J. H. Le Keux.

CHAPTER VIII.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE CORN CROPS, MANY OF THEM IMPROPERLY CALLED WIREWORMS; INCLUDING GROUND-BEETLES, CHAFERS, OR MAY-BUGS, ALSO THE CATERPILLARS OF A MOTH AND SAW-FLY, AND THE LARVÆ OF SOME MINUTE FLIES.

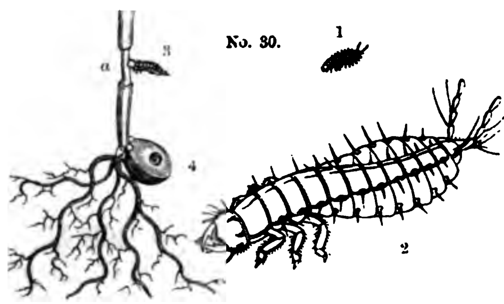
It being as much my earnest desire to impress upon the agriculturist the value of scientific knowledge, as it is my constant hope that the investigation of these subjects may enable him to detect more promptly his enemies, and likewise make him thoroughly acquainted with his friends, namely, the insects and other animals which Providence has ordained to subdue the noxious species, in order that the remedies suggested may be well directed, I am tempted to introduce as a preface to my present subject a paragraph from a practical and sensible author, who is equally convinced with myself of the value and importance of a knowledge of insect economy. "The different sorts of grain," says Köllar, "from the period when as seed they are committed to the earth, until they have attained perfect maturity, are exposed to the attacks of various kinds of insects. The farmer, who is entitled, when the weather is favourable, to expect a plentiful crop from the soil, often finds his hopes disappointed, without being able to imagine the cause. An insect which escapes his notice from its minute size, as well as from the difficulty of finding out its abode, is at work destroying the fruit of his labours. The agriculturist who is unacquainted with the economy of insects, seeks in vain for the author of this destruction, and not unfrequently attributes it to creatures which, in reality, are his benefactors."*

In the investigation of the insects infesting our corn fields, I shall proceed with the growth of the plants, as nearly as my materials will allow, and trace the ravages occasioned by the various species that feed on the roots and stems, others which attack the flowers and ears in the field, and those which consume the grain when housed. It is therefore only necessary to remind the reader, that the history of the corn insects was commenced in

* Köllar's *Natur. der Schäd. Insecten*, p. 98; and Köllar's *Treatise on Insects*, p. 86.

our last chapter,* in the account of the wireworms, which attack the stems close to the roots.

In the *Linnean Transactions* for 1808,† are some observations by Thomas Walford, Esq., F.L.S., regarding an insect that was destroying the wheat, supposed by the farmers of Essex and Suffolk to be the wireworm. In October, 1802, Mr. Thomas Olley, of Stoke, near Clare, in Suffolk, showed Mr. Walford some green wheat which was dying and losing plant very fast, the reason of which he could not comprehend. On examining the plants, Mr. W. discovered three of the larvæ (No. 30, fig. 1; 2, magnified), two of which were in the act of destroying the wheat (fig. 3). "With their projecting jaws, these insects cut round the outside grass (fig. *a*), about 1 inch below the surface of the soil, to get at the young white shoot in the centre, which they eat: upon this vegetation is immediately stopped, and the plant dies. I suspect that they first eat the flour in the grains, which has not been drawn up by vegetation; for, when we touched them, they ran into the husks (fig. *c*); and two of the three insects I carried home in the husks, which appear to be their habitations, and probably the place where they change from the larva to their perfect state." ‡



It is now upwards of fifty years since these facts were promulgated, and yet we know no more of the economy of this singular little animal than Mr. Walford did. He was inclined to think it might be the larva of a Staphylinus, or rove-beetle, only that he considered they were entirely a carnivorous family, and the same objection may be made to its being the larva of a Bembidium, or some minute Carabus, which I suspect it to be. It is somewhat remarkable that one has never heard of the re-appearance of this insect; but that may be owing to all ravages of the kind being at once attributed to the wireworm, which unfortunately has hitherto stopped all further inquiry.

1. *Staphylinus?* § or *Bembidium?*—The colour of this larva, which is not ¼ inch long, is not mentioned; but in all probability it is ochreous or tawny: the head is armed with strong jaws for cutting, and furnished with

* Chapter vii. † Vol. ix. p. 156, and Plate 18, f. 1–3.

‡ *Linnean Transactions*, vol. ix. p. 157.

§ Mr. F. J. Graham bred some *Tachypori*, I believe, from larvæ which ate the stems of his seedling cabbages in a similar way; and about the same time I observed that mine had been nibbled by some insect. But I have no direct evidence of their identity.

feelers and two small horns; it has six thoracic legs, terminated apparently by single claws; there are two rows of spines down the back, and another on each side of the body, which is composed of eight segments, besides the anal one, which is furnished with a sort of tail or prehensile foot, and two four-jointed setæ or feelers, to be employed when walking backward, as the antennæ are in advancing forward (fig. 1; fig. 2 being the same highly magnified).

"The injury," says Mr. Walford, "which the public sustains by the ravages of these insects, may in some measure be calculated from Mr. Olley's loss in 1802: he sowed 50 acres of a clay soil with wheat; out of these 10 acres were destroyed by them, which were replanted by dibbling in 1 bushel of seed per acre. The price of wheat at that time was 8s. per bushel. We here observe one-fifth part of the quantity sown was destroyed by these noxious insects."

From data furnished by a gentleman of great experience and observation,* Mr. Walford calculated that "the quantity of wheat lessened to the market by the depredations of the wireworms is very frequently, if not annually, 60,000 bushels; which occasions to the farmer an additional expense of at least £15,750." This was merely the value of the seed resown on clover lays, old pastures recently broken up, pea and bean stubble, &c., dibbling in and harrowing.

2. *Harpalus?* or Ground-beetle.—Two curious larvæ of this genus were transmitted to me dead, in February, 1841, by a gentleman† who considered they were injuring his corn in a similar manner to the wireworms. As he did not succeed, I believe, in rearing them, I cannot determine what beetle they would produce, but probably some carabideous species, in which case I should be rather disposed to consider that they lived upon the wireworms, &c., but this is not a natural consequence, as we shall shortly prove, for although most of the Carabidæ are carnivorous, there are some which feed upon the corn crops both in their larva and beetle states.

This larva is 4½ lines long, hairy, of an ochreous colour, having an enormous head, but tapering towards the tail, which is rust-coloured; the face is sloped off gently, with a group of minute black dots on each side, looking like eyes; the two antennæ are porrected, slender, hairy, and five-jointed; the jaws are very strong, not crossing, semilunate, toothed internally, the apex appearing pointed, but it is rounded and black; the maxillæ are elongated, as well as the labial palpi, which are bi-articulate, the basal joint being the stoutest, the second long, incurved, slender, and tapering; the

* Allen Taylor, Esq., of Wimbush Hall, Essex.

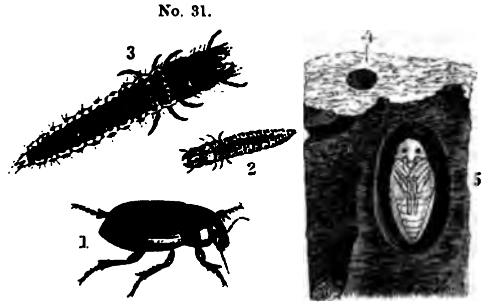
† W. J. Clark, Esq., of Buckland Tout Saint, Totness, Devon.

maxillary palpi are shorter and bi-articulate; the first thoracic segment is very broad and strong, of a ferruginous tint, the two following and the eight abdominal segments are of a dull ochreous tint, gradually tapering to the tail, which is furnished with a prehensile foot and two longish, tapering, articulated feelers; the sides of the body are margined and plaited: it has six pectoral jointed legs, spiny, and terminated by two long claws. I ought to state that in consequence of my not having seen the animal alive, it is very probable my description of the abdomen may be incorrect.

The economy and history of the next depredator have been carefully investigated by the German naturalists, and therefore are well known. It is a predaceous beetle which belongs to the order COLEOPTERA; it is comprised in the family CARABIDÆ, and forms with some other European insects the genus ZABRUS, and the species is named—

3. *Z. gibbus* by Fabricius, *Carabus tenebrioides* by Panzer, *C. spinipes* by Scopoli, and *C. gibbus* by Marsham.—It is convex and elliptical, but broad, of a deep piceous colour, smooth and shining: the mouth is ferruginous; the jaws are strong;* the antennæ are not so long as the thorax, filiform, eleven-jointed, and pubescent, excepting the three basal joints; the eyes are small, but prominent; the thorax is broad, a little narrowed before, all the angles are rounded, the sides margined, the surface is delicately striated transversely with wavy lines, and a channel down the middle, the base being depressed, thickly and coarsely punctured, with a shallow fovea on each side of the centre; the scutellum is trigonate, but minute: the elytra are a little broader than the thorax, but not so shining, with a faint olive green tinge, and are notched towards the apex; there are eight deep punctured furrows on each, the sutural one furcated at the base, and the outer one is strongly punctured at the shoulder and towards the apex; the wings are ample, and folded under the wing-cases; the legs are stout and bright ferruginous, the thighs are robust and piceous; the tibiæ are armed externally with series of short spines and dilated at their extremities, especially the anterior, which are well adapted for burrowing, they are notched near the apex and furnished with three spurs, the others have only two; the tarsi are slender with series of spines beneath, and are five-jointed, the three

No. 31.



* See Curtis's *British Entomology*, Plate and fol. 188, for the dissections, &c.

basal ones being dilated in the anterior pair in the males; the terminal joint is clavate, and produces a pair of claws. No. 31, fig. 1, represents the female slightly magnified, the length being 6 lines, the breadth nearly 3; the male is sometimes smaller.

The female beetle lays her eggs in clusters in the ground, and the larvæ they produce appear to be three years in arriving at maturity, from their being found half grown, in company with pupæ at the same season, and they frequently are accompanied by the larvæ of *Melolontha solstitialis*, "the Small or Summer Cockchafer." They are of a brown colour, the sides and under side whitish, nearly linear, but tapering at the tail, somewhat depressed, slightly hairy, and about 1 inch long; the head is broad and armed with two strong jaws, slender palpi, and two fine four-jointed antennæ, placed before the eyes: the first thoracic segment is very large and subquadrate, the second and third are shorter, as well as the nine abdominal ones; there is a transparent line down the back, a brown callous spot on each side of the segments, where the stigma or breathing-hole is situated, and above these is another line of brown warts, all thickened and producing hairs; the segments beneath have a similar callous spot at the middle of each, with four behind it, excepting the penultimate segment, and the anal one is brown and small, furnished with a proleg, and two short, pointed, hairy horns composed of three joints: the six pectoral legs are jointed and terminated by claws (fig. 2; fig. 3 being the animal magnified).

These larvæ, which seem to be closely allied to the foregoing species, bore into the earth, forming sometimes immense numbers of perpendicular burrows (fig. 4), which often commence in a curve, and extend from a few inches to 2 feet in depth; and when they are full grown they form at the termination of the burrow an oval cavity, smooth on the inside, in which they change to an exceedingly soft and sensitive pupa (fig. 5), of a yellowish white colour, with two little black eyes; and as they become more matured, the various members of the future beetle are distinctly developed. They remain in this state only three or four weeks, for the larvæ had changed to pupæ in the beginning of June, and at the end of the month and the beginning of July the beetles made their appearance.

So serious was the mischief caused by these insects in the vicinity of Halle in Saxony, in 1812, "that the Society of Naturalists in that city appointed a committee of its members to examine into the case on the spot." * They were first observed in a field of wheat which they devastated, and when wheat was again sown they destroyed it a second time: they then

* I am indebted to Köllar and his translator for many of the following facts, which had been, however, previously made known by Germar.

attacked the rye, and afterwards the barley. In the canton of Seeburg in Halberstadt alone, about 30 acres of corn were destroyed by the *larvæ*, and in July the *beetles* came forth in enormous swarms, crawling by night up the straws and eating the grains in the ears, * but concealing themselves by day under clods of earth, stones, &c., so that the beetles were nearly as mischievous as the larvæ; † but it seems probable that when the beetles appear in excess the mischief may remedy itself, for when they cannot find corn to feed upon, they will attack and destroy each other, such at least was the case with some confined in a box.

The larva, however, is the most formidable enemy; it issues from the earth by night, and eats into the stem of the corn close to the surface and feeds upon the pith, retiring on the approach of day, and lying concealed upwards of 6 inches deep in the earth. "Their devastations were confined to the *corn fields*, and were comparatively trifling even in those fields where vetches or potatoes were cultivated with the wheat; and the wheat, rye, and barley fields contiguous to vetch and potato fields were not attacked. In a field which had been first sown with wheat, and destroyed, and again sown with wheat and vetches together, marks of the devastating powers of the insects on this second sowing were observed, together with a number of pupæ in the earth. The destruction commenced in those fields which lay near pastures, in the vicinity of rape, fallow, and stubble fields, and spread from them: as the ravages were greatest in the beginning of spring, the larvæ appeared to have retired to the pasture lands for their winter-quarters, and thence proceeded to attack the neighbouring fields. Their great numbers in fields lying near stubble and fallow fields is easily explained, as they are the offspring of those which, the preceding year, lived on the crops grown in those fields."

Signor Passerini of Florence also notices, in a memoir, "the ravages occasioned by larvæ in the winter and spring of 1832–3, on the wheat in the provinces of Bologna, Romagna, and Ferrara, by devouring the cellular tissue of the leaves and stalks of the young plants, and thus causing them to perish: these attacks are made in the night time, the larvæ concealing themselves under ground during the day. They had been ascertained by Professor J. Bertolini, of Bologna, to be the larvæ of *Zabrus gibbus* and *Calathus*

* There are other Carabidæ which, it is presumed, live upon seeds and vegetables. Mr. Ingpen states that a specimen of *Pœcilus cupreus* was taken in the act of devouring a common pea (see *Transactions of the Entomological Society*). I frequently find some of the smaller Amaræ on rushes, &c., by the sides of ditches; and *Curtonotus aulicus*, a species nearly allied to Zabrus, is far from uncommon on the foliage of thistles.

† The beetles feed earlier in the year upon the milky grain as barley comes into ear. See *Entomological Magazine*, vol. ii. p. 182.

latus,* and appear to be equally injurious. Signor Passerini suggests to plough up the land, and then to turn in a flock of poultry, which would greedily pick up the larvæ."†

The Halle committee also recommended that the crows and other birds which live upon insects should on no account be destroyed, and they suggested that children might be employed in the fields to turn over stones and clods in the day-time for the beetles, and in the evening and at night they might be swept off the ears of corn with a net formed of a ring of strong wire, having a bag attached to it made of coarse canvas, about 18 inches long; the ring must have a ferrule to fasten it to the end of a strong light stick. As soon as the first slight frosts set in, the end of autumn, the infected lands should be ploughed deep, by which means the larvæ would be exposed and killed, or picked up by rooks and other birds; but it is said that this process, to prove efficacious, must be persevered in for many successive years, and by all the farmers simultaneously. The sulphuric acid contained in peat-ashes, and liberated by rains, renders them very advantageous in destroying these insects: the ashes should be strewed thickly in the spring on the autumn sown fields.

It is true that these insects have not as yet been ascertained to have attacked the crops in England, like those we have recorded on the Continent: favourable circumstances, however, may increase their numbers, so as to render them at some future period a pest in this country, for the beetles are found scattered about. I have not unfrequently picked up specimens in August and September in sandy corn fields in Norfolk, Kent, and the Isle of Wight, and they have been detected at the roots of grass nearer London; several were also taken off umbellate plants in Hants;‡ and that they live through the winter has been ascertained by Mr. Tulk, who kept several individuals alive for many weeks during the winter of 1837–8 by feeding them on corn.§

4. *Harpalus ruficornis*, Fabr.‖—Although there is no record of this insect injuring the corn crops, it is frequently so abundant on arable land that I think it probable its economy may be very similar to that of *Zabrus gibbus*. On the 7th of July, 1848, about sunset, after a hot day, I went into a wheat field at Hayes, Middlesex, where I saw numbers of this ground-beetle upon the ears of corn; they were running up the stalks, and their great delight was to get on to the tip of the ear, where they moved their heads as if about to feed: on some ears I observed two at once; and as I could count twenty

* I find Zimmermann has stated that other Carabidæ, *Amara communis* and *A. trivialis*, feed also upon the wheat.

† *Trans. Entom. Soc.*, vol. i. p. liv.

‡ Curtis's *British Entomology*, fol. 188.

§ Köllar's *Treatise on Insects*, p. 91.

‖ See Dawson's *Geodephaga Britannica*, p. 139.

around the spot where I stood, there must have been thousands thus occupied. At the same time they were very abundant in the garden, house, and out-houses at Hayes, being more numerous than I ever remember them before. Whilst I was writing, one fell upon the paper, and when I visited Fontainebleau in 1830, several of the beetles flew to our candles in the evening, showing that they are nocturnal, and provided with ample wings for flight. I am not acquainted with the economy of the larva, but in all probability it is similar to that of *Zabrus gibbus*.

There are also two species of carrion-beetles which are found not unfrequently in corn fields, where they appear to undergo their transformations. The first is named—

5. *Silpha obscura*, Linn.—It is of an obscure black colour; the thorax is finely punctured; wing-cases with three slightly elevated lines, which do not reach the apex, the central one being the longest; they are deeply but sparingly punctured; length from 6 to 8 lines.

M. Ghiliani informed me, that near Turin, the beetle eats into the young leaves of the wheat, but they are likewise carnivorous; and M. Blisson has stated that he observed the larva running in a sandy field, on the 18th of August: a few days after, it became a pupa in the sand, and the beetle hatched on the 20th of September. He says they live probably on little caterpillars, or larvæ weaker than themselves, and even on vegetable substances.*

The second species is—

6. *Silpha reticulata*, Fabr.—It is similar in form to the foregoing species, but is rather smaller. It is dull black; the thorax and wing-cases are punctured, the latter are wrinkled transversely with three elevated lines, the two next the suture being indistinct and irregular, the external one the shortest.†

We have introduced this species on the authority of M. Ghiliani, who told me that the beetle feeds on the leaves of the wheat when coming into ear.

We learn from Köllar that there is a species of beetle called the "Field Cockchafer," which is injurious to corn. This insect likewise belongs to the order COLEOPTERA, the family MELOLONTHIDÆ, and the genus ANISOPLIA: the species was named by Linnæus—

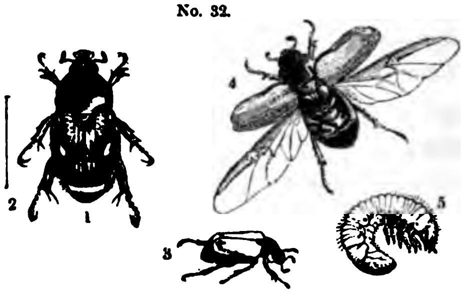
7. *A. agricola*.—Head and thorax deep green, thickly and minutely punctured, with pale pubescence, and a channel down the middle: the head is narrowed before, forming a produced clypeus, with a recurved margin: antennæ

* See *Annales de la Soc. Ent. de France*, 2d series, vol. iv. p. 69, and Plate 2, No. 1, f. 3, for figures of the larva and pupa.

† A correct notion of these beetles will be obtained by reference to Curtis's *British Entomology*, Plate and fol. 742, where a closely allied species (*S. opaca*) is figured; and also to a subsequent chapter and plate of this volume, where the history of this species will be given.

small and nine-jointed, the little club being trilobed: the eyes are small and lateral: the thorax is twice as broad as the head, slightly narrowed before, the sides rounded, the base sinuated: elytra ovate, rather short, broad, shining rusty ochre, they are covered with crowded faint punctures and several indistinct striæ; a black square spot surrounds the scutellum, which is rather large, black, and semi-orbicular; the shoulders and external margin are irregularly black, and there is a curved interrupted piceous line across the back, but these spots are more or less ferruginous and brown in different varieties: wings ample: the two last segments of the abdomen are exposed, black, and densely clothed with yellowish white depressed hairs, as well as the under side of the abdomen; the apex is conical and the hairs at the tip orange: the legs are strong and punctured, piceous with a greenish tint: the anterior tibiæ are dilated and bilobed externally, the others are short, spiny, and spurred; the tarsi are five-jointed, the claws are unequal, and the inner one is bifid, but obscurely so in the two hindermost: length about 6 lines; breadth, 3: No. 32, fig. 1; 2, the natural length.

No. 32.



These beetles are abundant on the Continent, and are found sitting singly or in little groups on the ears, nibbling the soft grains of rye, and of wheat, which is still more to their taste. Köllar says he has found ears which had been robbed of a third part of their seeds by these insects, but he had not ascertained whether the larvæ attack the roots of the corn, or subsist only on manure, and no means can be resorted to for destroying them, as they live in concealment: he adds, "Crows, moles, and field-mice are their greatest enemies, and should therefore be spared, when their numbers are not so great as to make them injurious." * Although common in France, Germany, and Italy, *Anisoplia agricola* is very rare in England, and my principal object in introducing it is to call attention to the May-bug, which is nearly related to it, and exceedingly abundant in hedges and corn fields; but whether it be prejudicial to our crops of corn I am not able to learn at present. It seems to be a general feeder, for in May, 1833, it destroyed the roses, devouring both the flowers and leaves, so that in some gardens scarcely a plant was left untouched, and they hung upon the flowers like swarms of bees: † the previous year the apple and nectarine trees fell a sacrifice to their ravages. In the

* Köllar's *Natur. der Schäd. Insecten*, p. 104.
† Curtis's *British Entomology*, fol. 526.

Lake districts of Cumberland, these beetles are called *bracken-clocks* by anglers, from their frequenting the fern, and are employed as a bait for trout. Stewart asserts that they destroy every sort of fruit tree, excepting the common pear; and Mr. Dillwyn says, near Swansea they are "extremely common every summer, particularly on roses, and appeared in immense numbers in 1814, when on their first appearance the sparrows on my lawn were so gorged with them, that several were unable to fly."* They were also in such multitudes on the acacias near Petersfield, that the foliage was consumed, and when the trees were shaken they fell down like a shower of hail.† I have also observed them in June and July feeding on bramble leaves, which they perforated like a sieve, and likewise on the eglantine.

This beetle, which belongs to the same order and family as the foregoing species, was named *Scarabæus horticola* (the Garden-chafer), by Linnæus, and is now called—

8. *Anisoplia horticola.*—It is very glossy, and sparingly clothed with longish hairs, dark on the upper side and yellowish beneath: the head, thorax, and scutellum are bright green, sometimes with a violet tinge; the head is thickly and roughly punctured; the thorax finely and more sparingly; the clypeus is broad and nearly semicircular, the margin reflexed: the nine-jointed antennæ are ferruginous, the trilobed club and palpi are piceous: the elytra are bright tawny, elliptical ovate, with seven distinct and several obscure irregularly punctured striæ on each: wings ample: the apex of the abdomen, called the pygidium, is exposed and bottle-green: the under side and legs are greenish black, the anterior pair being the stoutest, the hinder the longest; the first pair of tibiæ are notched externally, forming two distinct lobes or teeth in the males, the others are spurred at the apex; the tarsi are five-jointed and spiny beneath, the terminal joint is clavate, and furnished with unequal claws, the internal one being broad and bifid in the two anterior pair, the hinder ones being simple: length, 4½ lines; breadth, 2¼: fig. 3; 4, the same flying and magnified. These beetles might be collected into bags by children, and after being crushed or killed in hot water, they may be given to poultry, which fatten well upon them. The best period for this picking is early in the morning, as the beetles are torpid and sluggish when the dew is upon them.

It is, however, the larvæ which are so destructive, especially to pasture lands, and they would therefore more properly form a portion of a future chapter; but as it will be equally serviceable to complete the descriptions and economy of the insect at once, I have added a figure of the maggot, which

* *Memoranda relating to Coleopterous Insects*, p. 31.

† *Gardeners' Chronicle*, vol. iv. p. 700.

can be referred to when we arrive at the insects affecting the artificial and other grasses, at which time the best modes of extirpation will be discussed.

These larvæ are very similar to those of the cockchafer (*Melolontha vulgaris*), but much smaller; they generally lie curved up, somewhat in the form of a horseshoe (fig. 5), yet they are rather active, and can walk tolerably well, dragging their heavy bodies after them: they are of an ochreous white colour, but the head is deep ochreous and destitute of eyes; the two little horns are very distinct, slender, and five-jointed, the mandibles are somewhat rust-coloured and black at their tips, the body is clothed with a few brown hairs, the heavy apex being lead colour whilst the animal is feeding, but it is like the rest of the body when the stomach is empty: and it has nine spiracles on each side: on the breast and immediately behind the chin are six longish legs, clothed with bristly hairs, they are tri-articulate, the third joint short; the claws are small and acuminated, with one or two bristles on the sides. They form cells of the surrounding earth at a considerable depth in the soil they inhabit, where they undergo their transformation into delicate pale coloured pupæ.

I shall now have to treat of some insects affecting the ears of corn, and I shall avail myself of the information obtained from Dr. I. W. Calvert,* to make the agriculturist acquainted with a caterpillar which is very destructive in some districts. Dr. Calvert says, in a letter dated January, 1841, "I have been much annoyed at Snilesworth, for the last three years, by a brown streaked grub, or small caterpillar, about 1 inch long, attacking the wheat-ear, chiefly in the manner of a leech sucking. It pierces the chaff, and empties it of its contents, whether in a milky or farinaceous state. I have left some at the Entomological Society's rooms, and have attended two of their meetings, but could not hear of anything of this sort ever being observed before, nor can I learn that they have been noticed by any of the tenants at Snilesworth. They first made their attacks about the beginning of September; so that if I can hasten the harvest by forward sowing in the previous autumn, they may find themselves too late to do material mischief; hitherto, however, it has been more than we could do to get the corn ripe at all, the seasons having been so wet of late. I have some of the caterpillars confined in the earth, where they have buried themselves, and hope to give a better account of their origin and history next year." The following August I received a communication from Dr. Calvert, saying that these caterpillars had not been observed in the previous year until the 1st of September, when they were from ¼ inch to ½ inch long; that in the standing corn they perforated the chaff and nearly emptied the grains of their contents. During the reaping of

* Of Snilesworth, Yorkshire. Communicated by Professor Henslow.

the harvest they were also found lying on the surface of the ground; and in the stack or barn, after the corn was carried, committing their depredations there. In the month of November Dr. Calvert gave me several of the caterpillars, which were feeding upon wheat-ears in a bottle; some of them were not more than ¾ inch long, whilst others were more than 1 inch in length, but were scarcely so robust, except when they drew themselves up; these were of a dull rosy brown, freckled, wrinkled, and sparingly clothed with short hairs; the head was horny, of a dull chestnut colour, with two black stripes on the face; the first thoracic segment was horny also, shining and piceous, with three yellow stripes, the central one extending the whole length of the back, and distinctly defined with dark edges, the lateral ones are continued along the sides, but these become duller and are less distinct; they approximate at the tail, where the intervening spaces are piceous; each segment bears four black dots, the hinder pair being farthest apart: there is a brown irregular line along the spiracles, which are black.*

It is remarkable, but in conformity with the usual laws of creation, as regards insects at least, that when a species becomes abundant in one district, in all probability it will make its appearance simultaneously over the whole kingdom, and this has been the case even with species that had up to a given period been very rarely seen. Such was the case with these caterpillars, as will be evident by comparing the following dates with the previous ones: for in the beginning of September I received examples from a friend in Surrey, saying that the rubbed-out produce of some rye from seeds found in a sample of Spanish wheat, in 1839, was full of them; again, in August, 1841, the same party transmitted me more specimens, which I will describe, as they differed at this period from Dr. Calvert's full-grown examples: one of them was pale green, with four reddish brown stripes forming three yellowish green lines down the back; the head and pectoral feet were brown, the first thoracic segment slightly horny and shining, and each of the abdominal segments had four black dots between the stripes, as in the larger ones; a black dot characterized the spiracles, and there were three or four black dots on the thighs and feet, on the pale green, which extended under the body; down the centre of the belly were five or six dusky spots. I should not omit to mention, that I also received this caterpillar in the beginning of June, 1844, from Mr. M. Saul, of Garstang, Lancashire, who discovered it upon the young wheat, but it did not appear to be very abundant; it was ¾ inch long at that early period.

* As we have not succeeded in rearing the moth from this caterpillar, it is still very doubtful whether it be the *Noctua tritici*, or the *Eremobia ochroleuca*, Esp., which is abundant on the coast during July, August, and September; and the caterpillar is reported to live upon the standing wheat crops in the middle of June, on knapweed and other flowers around corn fields.

Dr. Calvert also informed me, that he was preserving the seeds of grasses, and consequently the grass is not cropped; and as he finds these caterpillars feed upon the seeds, he suspects that they are thus nurtured until they are attracted by the wheat crops; they are by far most abundant on the heads of grass in seed, particularly the fescues and cock's-foot; and the grass seeds matured by the end of July and beginning of August are not infested by them.

It seems probable that these caterpillars do not generally appear in great numbers, and only in their first skins, until the wheat crops in many parts are harvested in good seasons; but in the more northern counties they may prove very destructive to the standing corn, where the crops are later in arriving at perfection; and as they must often be carried into the barn or stacked with the wheat, their presence may be dreaded anywhere, especially when we find them injuring the corn to the extent observed by Dr. Calvert, who states that Colonel Le Couteur's improved Talavera, and many other wheats, had suffered to an extent of about one-third of the crop; and what is remarkable, they had not been detected in the neighbouring fields. In many of the ears, the grains had only small holes in them, but multitudes were nearly or entirely eaten out, the skin of the wheat alone being left. One which I put upon a dried ear of corn immediately began to eat into the grain, so that in a short time it was concealed, and the pure whiteness of its excrement showed the goodness of its food as decidedly as the quantity did its rapid progress, and the celerity with which it was digested. On taking out the grain I found a hole in the top just at the base of the stigma, and on opening it nothing but a thick shell was left. It is a remarkable fact, that amongst the corn infested by the caterpillars Dr. Calvert found numbers of the horny heads, which convinces him that they will live upon each other; and as the heads are not merely the horny shell, and often have the first thoracic covering of the segment adhering to them, I am of the same opinion.

These larvæ have no doubt been troublesome abroad, for in a memoir by Dr. Herpin, he says, "At the approach of harvest I have found a pretty large quantity of stems of wheat which contained near to the ear, between the leaves, a thick caterpillar of about 2 centimetres long (nearly ¾ inch), of a yellowish gray, rayed upon the back, and appearing to me to be the larva of a Noctua. This caterpillar, which is found also in the barns many months after the harvest, gnaws and devours the interior of the grains of wheat yet adhering to the ears, and deposits between the leaves large excrement of a whitish colour." *

* Extract from the memoirs of the *Soc. Royale et Centrale d'Agriculture*, for 1842, p. 29.

Dr. Calvert, I find, "read a notice (before the Entomological Society) of the attacks of one of the Noctuidæ upon the ears of standing corn, which led to a discussion, in which it was suggested that the only advisable remedy against the attacks of fresh broods of these insects, was to subject the land to repeated ploughings after the crop had been got off, and the insects gone into the earth to undergo their transformations, in order to expose them to the rooks, as well as to the action of the atmosphere."* As we have seen, however, that numbers of the caterpillars remain in the ears, and are consequently stacked or housed with the grain, and feed until the winter, when in all probability they hybernate, any application to the soil in this instance would not have the desired effect.

In what way these caterpillars undergo their transformation to the chrysalis state is uncertain; if it be in the refuse chaff, then those which are housed in the barn may escape in the chinks of the floor and round the walls; or, as they are very active, and great ramblers, as all caterpillars are, when they are about their final change, they may succeed in getting out of the building at the appointed season, and secrete themselves in herbage or in the earth, to become chrysalides; and of course those which inhabit the stacked corn have no difficulty in finding situations suited to their wants. I have repeatedly endeavoured to rear the caterpillars, but they always shrivelled up and died. I once, however, found some larvæ in January so exceedingly like these, if not the same, under the bark of willow trees outside of a stack-yard, which subsequently spun up there and produced *Noctua* (*Caradrina*) *cubicularis*, that I am strongly impressed with the conviction this is the moth which produces these destructive caterpillars.†

The above species belongs to the order LEPIDOPTERA, the family NOCTUIDÆ, and is named by Hübner—

9. *Caradrina cubicularis*—the Pale Mottled Willow-moth.

It is also the *Noctua quadripunctata* of Fabricius, and the *Noctua segetum* of Esper.‡ It is of a brownish mouse colour; antennæ like bristles; eyes fuscous; palpi short and scaly, with a pitch-coloured patch on the outside; abdomen rather slender, obtuse at the apex in the males, conical in the females: wings lying horizontally and incumbent in repose, forming an elon-

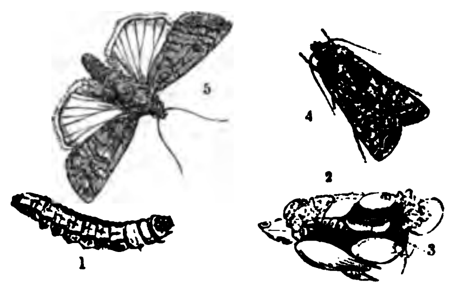
* *Transactions of the Entomological Society*, vol. iii. p. xxxv.

† Mr. F. J. Graham, as well as myself, has since bred these moths. The caterpillars are fleshy, and vary in colour from a dull ochreous red to a dirty green; the heads are blackish; and on the first thoracic segment is a horny scale, with two brown spots; the abdominal segments have a wavy line on each side, edged with black, leaving a pale space down the back; No. 33, fig. 1. They spin a few grains of wheat loosely together (fig. 2), and become pupæ inside, shining and of a bright brown colour (fig. 3).

‡ Curtis's *British Entomology*, fol. and Plate 651.

gated triangle (No. 33, fig. 4), superior long and narrowed at the base, with three irregular and crenated transverse lines, forming little black spots on the costa; the first is near the base, the second before the middle, and the third beyond it; between these is a round and kidney-shaped spot; between the third and the posterior margin, which has a line of black dots, is a sinuated ochreous line, reddish and suffused on the inside, the external space dark fuscous; inferior wings pearly white, slightly tinged with brown next the cilia, the nervures brownish: length, 6 lines; expanse, 14 or 15 lines (fig. 5.)

No. 33.



This moth is common in hay fields and about hay-ricks in May, June, and July, as well as on willows in gardens, &c.

10. *Noctua (Agrotis) tritici*, Linn.—the Wheat Full-bodied Moth—has long been known as an enemy to wheat crops. The larva is naked and yellow, with three white lines; it feeds on the ears of wheat and grass, and keeps under ground during the day.

The moth is ashy brown; superior wings, with an oval and ear-shaped pale spot on the disk, and a dark elliptical one below; also two wavy lines beyond, and between them is a row of pointed black streaks; the pinion edge is spotted; inferior wings dusky, white at the base in the male; legs annulated with white. It expands from $1\frac{1}{4}$ to $1\frac{1}{2}$ inch.*

It is abundant from the beginning of July to the middle of August, in pasture and grass lands, resting on the long grass and ragwort flowers.

The history and economy of another species of moth has come to my knowledge, which I believe to have been entirely unknown until Mr. F. J. Graham succeeded in rearing the moth from the caterpillar. It is one of the night-flying moths, called *Noctuidæ*, and belongs to a genus named *Apamea*, which contains about thirty British species. It has been stated that the caterpillars of some of the species live in the stems of grasses, and the moths are occasionally in the greatest abundance during the months of July and August, in fields and pastures.

The species which is injurious to wheat crops has been named—

11. *Apamea didyma*, Bork; var. I-*niger*, Haw.—the Common Rustic Moth.

This night-flying moth is fuscous, the upper wings have a darker central

* See Godart's *Hist. Nat. des Lépidoptères de France*, vol. v. p. 225; Plate 65, figs. 4, 5.

fascia bounded by two pale lines, which unite and form a black streak on the inner margin, resembling the letter I; a little beyond the centre is an ear-shaped spot variegated with white and brown, and nearer the base is a smaller circular one: the hinder margin is clouded with fuscous, and at the base are two short black lines; hinder wings and abdomen smoky: when at rest, the wings meet over the back, forming somewhat of a triangle; but when expanded, they are about 1¼ inch long.*

Owing to its being a most variable moth in colour, the different varieties have been described under various names.†

I first received caterpillars of this moth on the 5th of March, 1846, from Mr. Baker, of Alton; they were forwarded to me with the wheat plants, in the stems of which they were feeding, and they burrowed downwards to the roots; they were smooth, and of a shining palish green colour, with a brownish head, six pectoral, eight abdominal, and two anal feet: the spiracles being distinct down each side. At that time they were ¾ inch long, and about as thick as a crow-quill, but I failed to rear them; Mr. Graham, however, was subsequently more successful. On the 8th of April, 1850, this gentleman brought me a wheat plant with the outer leaf rusty, and at the base was one of the above described caterpillars, with its head downward, and not quite full grown. On the 15th of April, Mr. Graham found three more in wheat stems at Cranford; which, by the 2d of May, had attained to 1 inch in length, and two of them entered the earth to change to chrysalides. I am indebted to Mr. Graham for the following additional interesting observations. He states that the habit of this caterpillar is to crawl up a fresh stem of wheat, about 4 inches from the ground, and stop at the apex of the sheath, at which point it is expanded into the blade, where it commences gnawing a hole in the main stem with its head downward; and in the course of a few hours it thus completely buries itself in the tube of the stem, and having eaten the main stem quite through, it usually falls out of the sheaf; where, therefore, these fallen pieces are seen on the ground, they readily lead to a discovery of the caterpillar. It will continue thus within the sheaf, secure from observation, gnawing the tender stalk regularly round within, until it has consumed every portion of it quite down to the root, leaving the sheath partly occupied with its fæces. When the caterpillar has destroyed one stem, it crawls out to attack a fresh one in a similar manner. Three caterpillars thus in about a fortnight ate upwards of thirty stems; one of these, which had rested quietly in a stem for at least three weeks, disappeared on the 3d of June, and probably descended into the earth. When the caterpillars entered the earth,

* See Wood's *Index Entom.*, Plate 12, f. 268.

† See Curtis's *Guide*, Gen. 848, and *British Entomology*, fol. and Plate 260.

they formed a substantial cell about 1 inch below the surface, within which they changed to chrysalides, and they were thus occupied from the middle of April until nearly the end of May. The moths were hatched on the 30th of June and 5th of July.

It is evident that when these caterpillars are abundant in wheat fields, as in all probability they often are, that very considerable damage must be the consequence. We are still ignorant where the eggs are deposited by the female moth, and it has not been ascertained where the young caterpillar feeds in its earliest stages, but I entertain little doubt that it will be found they penetrate the stem, and reside there.

I had communicated to me the larva of a saw-fly which was found in abundance on the ears of wheat near Cardiff, in Glamorganshire, and as there was something mysterious in its visit, and I have never met with any similar occurrence, the record of the fact may possibly lead to a more correct knowledge of the economy of the animal. It is of the order HYMENOPTERA, of the same family (TENTHREDINIDÆ) as "the Turnip Saw-fly;"* and from its figure and the number of legs, it appears to associate with the genus TENTHREDO; but without the fly which it would change to, it is impossible to speak with any certainty.

12. *Tenthredo?*—On the 3d of August, 1842, I received more than fifty specimens of these caterpillars; they were about ¾ inch long, rough, and of an orange brown cast, with a paler line down the back; they had six horny pectoral, fourteen abdominal, and two anal membranous feet; the head was large, horny, hemispherical, and ochreous, with a minute prominent eye on each side surrounded by a small black ring, and a minute horn before each. The jaws were strong and horny, meeting in front, subquadrate, pitch colour at the apex, one with strong irregular teeth, the other more crenated; the maxillæ were small, and furnished with a short, tapering, tri-articulate palpus.

I will now transcribe my correspondent's account of them. He says, "I find from my friend, that on walking through a field of wheat, at noon on Monday, he saw one of these caterpillars on the top of almost every ear of corn, perfectly inactive, and the corn not injured in any way. Great numbers still remain on the ears, almost all are quite at the top, some apparently impaled upon the sharp points of the husks of the uppermost grains, and only one on each ear. A large wood adjoins the field, and I should observe that almost all the caterpillars appear dead and dried up on the ears; and it was with difficulty I could find any at all showing signs of life." It was certainly a strange phenomenon, which came so suddenly, and appeared so

* Chap. ii. Plate B, figs. 6 and 7.

unaccountable, that the bailiff declared "they fell in a shower during the night." It is very remarkable that on the 6th of July, 1845, I saw great quantities of the same larvæ dead and dying, upon stems of grass in the marshes near Lea-Bridge, Essex. In 1847 I also found them at Glanville's-Wootton, on wheat, feeding upon the leaves.

We have now arrived at the history of a genus of small flies which is highly interesting; and although their depredations are well known, the habits of the various species had not been completely investigated until within the last few years. Opportunities of studying their economy having been offered, I commenced my observations some years since, but did not complete them until 1844, and I now find that Dr. Herpin had been engaged upon the same subject, by a pamphlet upon *Chlorops*, &c., which has lately appeared, with plates and additional observations, by M. Guérin-Méneville. My investigations, therefore, have no longer the charm of novelty, but they may yet strengthen the observations already promulgated, and will not prove uninteresting to the agriculturist, when combined with the facts recorded by my fellow-labourers in science.

As the documents relating to these insects are very numerous, it may be as well to preface my narrative with an outline of their general economy. When the incipient ear is formed, but concealed in the sheath close to the first knot, or even at an earlier stage of growth, the wheat and other corn plants often droop;* on opening the stem a maggot is found; this changes to a pupa higher up, from whence eventually emerges the legitimate fly, or some parasite which feeds upon the larvæ. The earliest intimation we have of these pests is in the Stockholm *Transactions*, first by Linnæus, and secondly by Bierkander. Gmelin, Fabricius, and others, have described the species in their works; and subsequently we find an excellent paper in the *Linnean Transactions*, as well as more recently the *Memoir* of MM. Herpin and Guérin-Méneville, besides notices in many other works, which I shall endeavour to embody in my narrative.

13. Oscinis pumilionis, Bierk.; Chlorops glabra, Mieg.?—Bierkander† describes one of the species, which he calls the *ryeworm*, and the following is his accurate account of this insect, which he named *Musca pumilionis:* ‡—"In the month of May, 1778, I perceived some dwarf stems amongst the rye, from 1 inch to 3 inches long. On examining them, I discovered that at their first joint there was a little worm, which caused this singular growth. In

* This, it will be also remembered, is the case with the wireworms.

† See the *Transactions of the Royal Academy of Stockholm*, vol. xxxix. A.D. 1778, pp. 240 and 241; also the *Transactions of the Linnean Society of London*, vol. ii. p. 79.

‡ Thus named from its causing dwarf and abortive grains in the ears.

order to trace at leisure the metamorphoses of these worms, I took many specimens, which were put in a glass bottle.

"The larva is white, 2 lines long; it has ten segments; the head is pointed, black at its extremity, forming a Λ. The first began to change to a pupa on the 25th of May.

"The pupæ are yellow and shining, a little more than 1 line long, depressed and annulated. They began to produce flies on the 12th of June.

"The imago, or perfect fly, is a little more than 1 line long; its head is yellow, and its eyes black; it bears at the nape a black triangle: the black antennæ are a little knotted, and produce some hairs: the thorax is yellow beneath, black upon the back, and marked with two slender yellow lines the whole length; below and near to the abdomen is a yellow crescent-formed spot; the fore legs bear two black spots; the abdomen is black above, yellow beneath, and is composed of four segments; the poisers are white; the wings glitter with red and green, and extend a little beyond the body; the legs are grayish at the base, black at the extremities.*

"I am still ignorant whether the eggs are deposited in the stalks of the rye; but the larvæ, which were yet small on the 23d of April, had acquired their full size on the 25th of May. I do not see any holes upon the sides of the stems, for which reason it would appear that the eggs or the worms are deposited upon the leaves. When we find any holes there, they are made by 'the whiteworms of the ear,' or other insects. When the fly has issued from the pupa, it climbs up the stalk and flies away.

"The quantity of dwarf rye, which began to grow yellow and decay on the 14th of June, amounted to from eight to twelve and fourteen in every 4 square feet. We see by this how much mischief the insect could do to the growth of rye; it is therefore necessary to pull up and burn the attacked plants, whilst the worms and the pupæ are inside. I have sometimes pulled up as many as 350 affected stalks in a few hours, and one or more persons could collect some thousands in a day, which would be of great importance, because then the numbers would be less considerable the succeeding years."

Gmelin † gives the following description of *Musca pumilionis*, which he considers the essential characters of Bierkander's insect:—"Black; under side, head, and two lines on the thorax yellow, halteres white, legs cinereous, apex black;" and adds, "The larva, which has an acute head and black apex, inhabits the stems of rye to an extent hurtful to their increase, as they scarcely reach 1, 2, or 3 inches in height."

Unfortunately there is no description of the species which we shall next

* Evidently related to our fig. 1, Plate H.

† Gmelin's *Systema Naturæ*, vol. v. p. 2849, No. 217.

notice, and the figures in the plate are not sufficiently accurate to determine if it be Bierkander's insect; but I am inclined to think not.* This excellent paper, being "Some Account of the *Musca pumilionis* of Gmelin's edition of the *Syst. Naturæ*, by William Markwick, Esq., F.L.S.," was read before the Linnean Society on the 1st of November, 1791.† He says, "Early in the course of the last spring some fields of wheat in the neighbourhood of Battle appearing to be much blighted, a friend of mine discovered it to be caused by a small insect of the grub or caterpillar kind, lodged in the centre or very heart of the stem, just above the root. About the latter end of March I procured some of the wheat, examined it, and found in most of it a small larva or caterpillar alive; but in some it was already changed into the chrysalis state.

"Being exceedingly anxious to determine the species of this apparently destructive animal, I planted some of the diseased roots in my garden under a hand-glass, where they flourished very much, and threw out strong shoots on each side (the middle shoot withered); but whether the flies escaped through some hole in the glass, or whether they were devoured by a colony of ants which made their nest under the glass, I cannot tell, as I did not succeed in this attempt, for when I pulled up the wheat and examined it, there was an empty chrysalis in each plant. However, I had better luck in my next attempt: I placed several of the diseased roots of the wheat in a small flower-pot filled with bran, and covered it over close with gauze, in such a manner that no insect could get in from the outside, nor could any escape from within. On the 14th of May three small flies were discovered sitting on the inside of the gauze. A few days after, three more of the same flies appeared. There were in the flower-pot of bran six roots of diseased wheat, which produced six flies. On examining the roots afterwards, I found an empty shell of the chrysalis in each, so that, I think, there can be no doubt of the identity of the insect in question.

"I mentioned that the larva and chrysalis were always found deposited on the principal stem, just above the root. This stem it invariably destroyed, which gave the crop a most disastrous appearance, so that there was scarcely a hope of any produce; but after the larva had changed into its chrysalis state the mischief ceased, and the root was not so materially injured as to prevent its throwing out fresh shoots on each side, or stocking itself, as the farmers term it, as I experienced by those which I planted in my garden.

* They are represented of a larger size than I conceive Bierkander's to be, and with *pale*, in all probability yellow, *legs*; there are also indications of four black stripes on the thorax in the smaller figures.

† Vol. ii. p. 76, of their *Transactions*.

"In short, at harvest time I was most agreeably surprised to find a good crop of wheat, and the ears large and fine throughout the whole field. My friend thinks it the best crop on his farm, and supposes he shall have about three quarters and a half of thrashed corn from each acre.

"The kind of wheat sown was a white wheat, lately introduced here from Surrey; my friend could not recollect with certainty its name, but thought it was called white Zealand wheat. None but what was sown early, about the latter end of September or the beginning of October, was affected by this insect; and in one field, where a part of it was early sown with white, and the other with red wheat, at the same time, the white wheat was much affected, and the red but very little. The reason why the early-sown wheat only was affected is, I should imagine, because the cold at the approach of winter destroyed the fly before the late-sown wheat was sprung out of the ground—consequently it could not lay its eggs in that. The soil is rather stiff, with a gravelly bottom."

I shall now proceed to give the observations made on the ravages of these insects, and their economy, in France. In 1812 the Société d'Agriculture de la Seine was officially consulted by the minister of the interior upon the subject of the considerable ravages made in divers parts of France, especially in the environs of Paris, by the destructive insects attacking the corn crops. These insects lodged between the leaves of the corn, and ate the young stems at the termination of winter. The greater part of the attacked plants withered and perished upon the spot towards the end of the following April. The celebrated naturalist, Olivier, was charged by the Society of Agriculture to study and publish the history of these insects in their *Transactions*, but his death prevented their completion, and the premature demise of M. Audouin again retarded this work; and it was subsequently resumed by Dr. Herpin and M. Guérin-Méneville.

14. *Chlorops lineata?*—"In 1812 it was observed that the corn recently planted presented, both before and after winter, alterations, occasioned by a larva situated above the root, which ate the leaves in the centre of the plant, causing it to turn yellow, and then to perish.*

"In 1839 Dr. Dagonet, at Châlons-sur-Marne, and M. Philippar, detected again some larvæ which caused in the spring a considerable swelling of the young wheat plant above the joint, destroying the central leaves and the plant itself. Towards the end of April or in May these larvæ were changed to the fly named *chlorops*. Olivier was perplexed to explain how the eggs laid in May could be preserved and transported to the young wheat plants,

* See Dr. Herpin's paper in the *Memoirs* of the Soc. Royale et Centrale d'Agriculture, 1842.

which are only sown in the October following. The pairing of the sexes takes place towards the end of May or the beginning of June, and the female is soon occupied in laying her eggs upon the stem of the wheat, which then commences to show the *ear;* the egg is deposited towards the lower part of the ear, at the bottom of the sheath of the leaves. About fifteen days after, there issues from the egg an oblong larva, yellow, and without legs, which attaches itself to the stem of the corn, immediately under the ear; it nourishes itself by nibbling a part of the surface of the straw, which is then very tender; it there traces and excavates an external groove about 2 millimetres broad, and 1 or 2 at most in depth, but which never penetrates into the interior canal of the straw. This furrow reaches from the base of the ear to the first superior knot, with some exceptions; for example, when the larva perishes, or when it is full grown before having attained the first joint.

"When nearly arrived at this spot, the larva has usually acquired all its growth; it is then transformed into a pupa, and fixes itself generally towards the middle of the furrow which it has scooped out on the exterior surface of the stem. In the following September the *Chlorops* hatches, which would live during many weeks, and then deposit her new eggs upon the *rye* and the corn quite recently sown.

"The stems of the wheat attacked by the larvæ proceeding from the second laying of the *Chlorops* present some differences so singular and remarkable, that it is surprising no one has up to the present time ascertained the cause; these alterations are generally attributed to a defect of vegetation, occasioned by certain uncongenial variations of the seasons. The stalks thus attacked are scarcely more than half the height of those which are healthy; their maturation is retarded considerably; they are still very green when the others have become yellow from the effect of ripening; the ears have not yet emerged from between the leaves which sheath them; they are short, small in bulk, and contain but few grains; these, moreover, are starved, concealed, and curved; lastly, all the series or files of grain situated on the side where one finds the longitudinal channel hollowed out by the larva are entirely abortive, and contain no grains."

It appears that in July, 1840, the pupa and perfect insect were alive, and in May the infected stems were abundant; and, from the number of ears which were injured where the researches were made, the loss was estimated at one-seventieth part of the wheat crop. Dr. Dagonet says, "The number was at least as considerable in our country, where one could not set a step without meeting with some ears not disengaged from their envelopes. If we add to these ravages of the second laying, the considerable number of young plants which perished in consequence of the attacks of the *Chlorops* prior to and after winter, we shall be convinced that this insect is a very formidable scourge to agriculture."

15. *Chlorops herpinii*, Guér.—Dr. Herpin also obtained a *musca* from larvæ which only attack the ears of the barley, and which Guérin has named *Chlorops herpinii*,* and he says that it resembles the *C. glabra* of Meigen,† and the "Mouche jaune à bandes noires" of Geoffroy.‡ This species certainly differs from all the specimens I have bred, as well as from those in my cabinet:§ it is yellow, and has only three black stripes on the thorax; the antennæ are black or yellow, with the anterior margin and seta black; crown with two black triangular spots; abdomen yellow; fascia and basal dots fuscous; tail black; legs yellow; the tarsi are all fuscous. He further says, "The barley (*Hordeum distichon*) is attacked with us by a *Chlorops* which appears to be the same as that which devours the stems of the wheat; it produces the same alterations, and scoops a longitudinal groove on the outside of the young stem under the ear."

"Besides that insect," says Dr. Herpin, "the barley is attacked by the larvæ of another *Chlorops*, much smaller than the preceding, which are found to the number of from six to ten in each ear; they eat the sexual organs of the flowers, and render the fructification imperfect, so that the ears are quite sterile.

"We often find also upon the same piece of barley, with the first-mentioned *Chlorops*, which eats the superior part of the stem, many other little *Chlorops* of the second species, which devour the ear. These two species undergo their metamorphoses in the manner already described."

16. *Musca frit*.—I must not omit to notice this little fly, which was first made known by Linnæus's memoir in the Stockholm *Transactions* for 1750, and concerning which there is much difficulty regarding the species, owing to the brevity of his description, and it appears to me that its economy is different to any of the other recorded species; as, however, all naturalists are agreed that it is a *Chlorops*, it will be better to introduce it here. In the *Fauna Suecica*‖ Linnæus describes this fly as having "setaceous antennæ, with black pile or short hairs; the balancers, hinder feet, and abdomen are pale green. It is the size of a flea (which is large in Sweden); the body is the form of *Musca domestica* (the common house-fly), black; very agile, as if dancing; eyes fuscous; hinder feet pale; balancers pale; abdomen fuscous, more of a pale green beneath:" he says, "It resides between the glumes

* Guérin's *Memoirs*, p. 30, Plate 2, fig. 9. † *System. Beschr.*, vol. vi. p. 149, No. 20.

‡ Geoff., *Hist. abregée des Ins.*, vol. ii. p. 503.

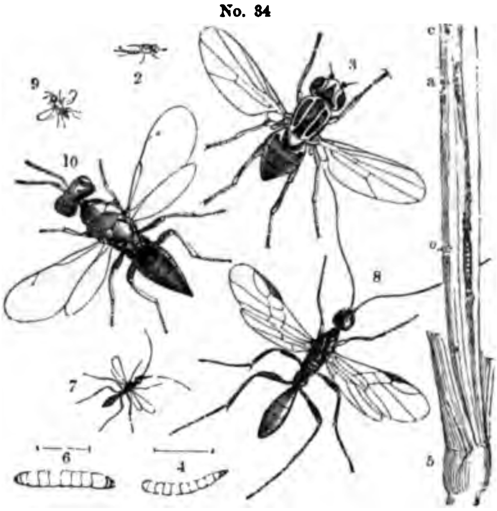
§ See Curtis's *Guide*, Genus 1345, where thirty-five species of these flies, comprised in *Chlorops* and the subgenus *Oscinis*, are recorded as inhabiting England.

‖ P. 456, No. 1851.

(husks) of the barley, and certainly destroys as much as one-tenth of the grain, causing the little, light, and worthless grains called *frits*, which are the greatest loss to husbandmen;" and he calculates the annual loss in Sweden at upwards of 100,000 golden ducats,* about the same sum in pounds sterling—an immense loss, if we consider the period at which Linnæus wrote, and the country he alluded to. It is found much farther to the north, the fly being, according to Zetterstedt, abundant everywhere in Lapland, on grass in arid situations, from the 5th of July to the 2d of September.†

17. *Chlorops tæniopus.*—I will now describe the first species which came under my own observation, and causes the disease termed in Oxfordshire the *gout* in wheat and barley, from the stalk being swollen to thrice its natural size. These flies belong to the order DIPTERA, the family MUSCIDÆ, and this species to the genus CHLOROPS, so called from its green eyes, and it is named by Meigen—

No. 34



C. tæniopus,‡ the Ribbon-footed Corn-fly (Plate H, fig. 1; and No. 34, fig. 2; 3, magnified).—Guérin considers this to be a variety of the following insects, which belong to the same species:—

Musca lineata, Fab.: *Ent. Syst.*, vol. iv. p. 356, No. 180.—*Oscinis lineata*, Fab.: *Syst. Ant.*, p. 215, No. 4.

Oscinis lineata, Lat.: in *Ency. Method.*, vol. viii. p. 566.

Chlorops nasuta, Meig.: *Syst. Besch.*, vol. vi. p. 142, not of Gmelin.

Chlorops glabra, Westw.: in *Gardener's Mag.*, vol. xiii. p. 289.

It is of a straw colour or pale yellow; the antennæ are porrected but drooping, black, small, compressed, and four-jointed; the basal joint being cup-shaped and bristly; second nearly orbicular; the third minute, short, and slender, inserted near the base of the second; the fourth a fine, rather short bristle, often placed at an angle with the third (fig. *l*): head rather large and hemispherical (fig. 3); face smooth; profile concave (fig. *m*); mouth received into a cavity beneath, composed of a bilobed lip, two palpi, a labrum, and

* Linnæus's *Systema Naturæ*, pars 2, p. 994, No. 90.

† *Insecta Lapponica*, col. 781, No. 12.

‡ *Syst. Besch.*, vol. vi. p. 144, No. 9.

tongue; at the base of the crown is a black triangle, on which are placed in triangle the three minute ocelli; the eyes are lateral and orbicular, remote in both sexes, green when alive, blackish or brown after death; thorax ovate-quadrate, very convex, and as broad as the head; down the back are three broad black stripes, the centre one equal, the lateral ones tapering behind; on each side of these is a slender short black line, not extending to the shoulder, and there is a black dot on the side of the breast; the scutellum is semicircular and yellow, with a minute dark spot on each side under the margin at the base, sometimes there are two rusty converging stripes on the sides, and the hinder margin is relieved by a transverse black patch; the abdomen is scarcely longer than the thorax and not broader, it is ovate-conic and depressed, formed of five segments, of a pale greenish black, the margins darker, forming four black bands when alive, and there is a minute black dot on each side of the basal segment; wings incumbent in repose (fig. 4, and No. 34, fig. 2), extending considerably beyond the tail, transparent, beautifully iridescent; costal nervure brown and extending to the submarginal nervure only (fig. *n*), which is brown also, the inferior ones paler, the two transverse nervures on the disk do not approximate; halteres clavate and white; six legs moderately long, simple, and slender, of an ochreous colour; the feet five-jointed, anterior black, with the second and third joints ochreous, intermediate and hinder with the two terminal joints alone black; claws and pulvilli also black; length, 1½ line; expanse, 3½ lines (fig. 2, highly magnified).

As I have great doubts regarding this insect being only a variety of Fabricius's *Musca lineata*, I have adopted Meigen's name; their economy is undoubtedly similar, but his description is too incomplete to enable any one to determine the point, and Meigen's insect is at once distinguished from all others of the genus by the pale band on the intensely black fore feet.

On the 7th of August, 1841, a friend informed me that, in going into a small wheat field in Surrey, it was lamentable to see the multitude of stems and ears that were injured and disfigured. The wheat had been transplanted, the stalks were scored, and in them were the chrysalides of maggots protected by the leaf. Upon inspecting the three stems that accompanied the communication, one of which is represented in Plate H, fig. 5, and No. 34, fig. 5, I observed an irregular brown channel commencing a short space above the joint (figs. 5, *o*), which extended to the base of the ear. At fig. *o* I found a shining brown pupa, from whence I concluded that the egg had been deposited at a somewhat early stage of the wheat, possibly in May or June, and that the larva fed, working its way down, within 1 inch or 1½ inch of the joint, where it was enveloped and secured by the leaves, and would no doubt turn round before changing to a pupa. I then split the stems longitudinally, and found that the channels formed by the maggot (No. 34, fig. 4), in no instance penetrated through, but that there was occasionally a corresponding thickening inside of the straw; I had seven pupæ, all of which appeared to be dead, excepting one (figs. 6), through the skin of which I could trace the embryo fly, which eventually proved to be the *Chlorops tæniopus.*

On a second examination I found in two of the ears that the larvæ had commenced eating about ½ inch above the base of the ear, and kept apparently on the surface of the stalk, which is, of course, very rigid, and one had passed over a grain which was impressed with a small channel; in another the calyx of the basal grain was perforated with a small hole which had rendered it abortive, unless the corn had been consumed. As the channel had passed over one of the calyces, where it was much narrower than below, and the kernels swelled, the line of connection was interrupted. Such were my first impressions; but, after reconsidering these appearances, I have come to the conclusion that the egg is deposited so that it may hatch when the ear is but just formed, and by then feeding on one side, the channel in the stalk is only the scar, which is elongated as the plant grows; if this be the case, my first theory is incorrect: but to show how cautiously one must proceed, I may mention that the specimens of wheat above alluded to were carefully preserved in a closed box, and on re-examining them on a subsequent occasion, I saw one of the stems had not been opened, and on splitting it a great quantity of white excrement fell out, which puzzled me greatly; but on proceeding in my search, I found that the canal terminated in one of the glumes, and there, to my surprise and satisfaction, I discovered a little beetle (the *Anobium paniceum*),* which had been feeding on the soft internal lining of the straw, with others which had escaped, and they were the cause of this unexpected and casual injury.

On the 16th of August, 1841, I bred the fly *Chlorops tæniopus* from one of the pupæ in the stems; the others produced parasites, of which I shall speak hereafter.

The same fly attacks the barley also, but apparently at an earlier period, for on the 2d of July, 1844, I received two plants from Sarsden, which were rank, and looked green and healthy, but, on unfolding the leaves, I found the central ones yellow, dead, and eaten, and the stem destroyed. Within 1 inch of the joint was inclosed a brown, shining pupa, like fig. 6, but smaller; in the other a similar one, but 1 or 2 inches higher up, and adhering to the inside of one of the outer leaves: in this plant the young ear of barley was eaten and become brown at the extremity. It was stated by my corres-

* See Curtis's *British Entomology*, fol. and Plate 387; and his *Guide*, Genus 290.

pondent that in his neighbourhood not a yard of any of the barley fields was free from this disease. About three weeks after, he sent me a larger supply of infected plants, which had a rank and gouty appearance; and informed me "that the disease was first detected when the barley began to shoot or stool; and when one stalk was infected, the remainder of the shoots on the same stool appeared stunted. I do not think any stalk with a maggot in it will ever throw out an ear." And of this I am also convinced; for in every instance the stalk was eaten, often nearly through, and the tender grain was more or less consumed by the maggots, especially towards the base, where it was the most matured; but it often happened that there was no indication of grain, the chaff only being developed.

Having found two specimens of the *Chlorops* with their wings crumpled, near the top of the spathe, I am satisfied that the flies crawl out from between the leaves as soon as they hatch, and there expand their wings; and the species I was able to identify by the colour of the feet.

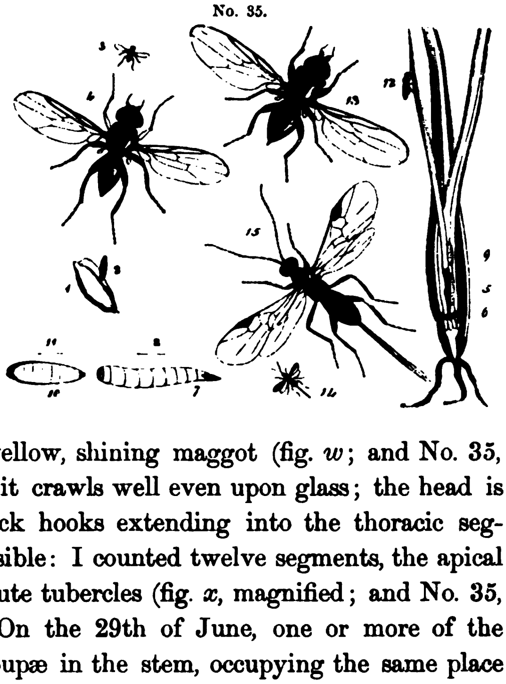
It has been said that this disease is confined to the most luxuriant crops; but this surely arises from the rank and unnatural appearance occasioned by the swelling of the stems. Some naked Nepaul barley was also infested with the *Chlorops*, which in August exhibited deep channels the whole length of the stems. It seems to attack rye and barley sometimes in preference to wheat; and perhaps there is not a year that this fly is not at work, but at intervals in such small numbers that the mischief passes unnoticed. There are some other species of *Chlorops*, which occasionally make their appearance in myriads: I remember witnessing the ceiling of a room which was absolutely discoloured by a very similar species, the *Chlorops hypostigma* of Meigen, if I mistake not, which swarmed in the autumn of 1834, when many persons informed me that it was not of rare occurrence at that season in Suffolk. I also received examples of this species in October, 1844, which "literally covered the ceiling of a bed-room" that had been white-washed, after scarlet fever had visited the house, which induced a supposition that the flies were the consequence. There were thousands also on the windows of an uninhabited house in the neighbourhood of Hayes in the second week of October.

I recollect that Mr. D. Sharp, a member of the Linnean Society, presented me with specimens of the *Chlorops tæniopus*, many years since, which he had bred from the stems of wheat in Huntingdonshire; and, more recently, the late Mr. Sells stated before the Entomological Society, that many acres of rye had been killed near Kingston, in Surrey, by these larvæ burrowing into the stem at the surface of the ground. In 1837 the *Chlorops* was observed in abundance, whilst removing a wheat stack, near Bristol, in the month of April, with the caterpillars of *Noctua cubicularis?* already noticed; and in the autumn of the same year, these little flies appeared in myriads in houses in various parts of the country. It is, however, very much to be regretted that it is impossible to ascertain if they were all of the same or different species, as the specimens are either lost or scattered about in various collections.

During the year 1844 a species was detected of similar habits, which had not been previously noticed. The first report of this disease was a communication from Mr. R. Arthur, of Edinburgh, published in the *Gardener's Chronicle* and *Agricultural Gazette*, June 1, 1844, in which the writer says, "There has been a remarkable failure of some fields of wheat around North Berwick, which have been ploughed down within the last few weeks. In early spring it promised as fine a crop as any in the country. Plants, however, here and there began to look sickly and to flag, which lay withered in the course of ten days. On examination, every stem of the plants attacked was found to contain a small grub, which enters about 2 inches beneath the surface of the soil, eats its way up the centre of the stem till it reaches the light, when it either dies or becomes transformed. The plants appear to reproduce fresh buds from the joint beneath the door of the grub, but the remaining vitality seems too weak to carry leaves to the air for respiration, far less to yield a crop." This was immediately followed by a letter addressed to the editor of the *Preston Guardian* by Mr. M. Saul, of Fort Green Cottage, Garstang, Lancashire, stating that he had discovered the grubs in wheat fields on the estate of the Duke of Hamilton in that neighbourhood; and, with the plants forwarded to the Royal Agricultural Society, he stated that the wheat was sown in December, February, and March; the first suffering the least from their attacks. The fields are a peat-earth, and were cropped with potatoes in 1843. On the 9th of June, and again on the 19th, Mr. Saul obligingly transmitted me some plants with the living maggots in them. The first two plants of wheat I received were 4 or 5 inches out of the ground, and withering (fig. 7); on pulling open the dilated base of one of the sheathing leaves, I found a small yellowish white, shining, fleshy maggot (fig. 8), surrounded by atoms of the stalk, which might have been digested, as they adhered together. It was perfectly concealed, with its head downward, and close to the base of the plant; it had already eaten through the central stem, so that I could draw it out with ease. This maggot was ¼ inch long; the body was gradually attenuated to the head, which was pointed, with two black horny points; the tail was terminated abruptly, with two brown tubercles and several smaller fleshy ones (fig. 8; and fig. 9, the same magnified). Unfortunately, these larvæ, as well as those forwarded a few days after, apparently died; for, as they were much larger than those sent at the end of June, I am disposed to think they may be different to the foregoing or following species; yet, on opening the stems in October, I found two dead larvæ, and on a leaf I detected a small empty pupa case, very similar to that of the species I am about to notice.

18. *Oscinis vastator.*—The wheat plants transmitted to me on the 19th of June I placed in a garden-pot, when they died I inclosed them in a stopper-bottle, and on the 5th of July I found a small black fly hatched (fig. 11; and No. 35, fig. 12; 13, flying and magnified). The plants of corn, whether of wheat or barley I could not ascertain, which I received on the 23d of June had the outer blades green (fig. 12, *s*), the inner one yellow or brown (fig. *t*); on pulling this blade it drew out, leaving the base behind, which was completely eaten through (fig. 13, *u*; and No. 35, fig. 6): the stem which I had drawn out was of a yellow colour, and about ¼ inch of it was eaten and dry (fig. 14, *v*), and just within I detected a small yellow, shining maggot (fig. *w*; and No. 35, fig. 5). Although it has no feet, it crawls well even upon glass; the head is attenuated, with two minute black hooks extending into the thoracic segments, through which they are visible: I counted twelve segments, the apical one being rounded, with two minute tubercles (fig. *x*, magnified; and No. 35, fig. 7; 8, the natural length). On the 29th of June, one or more of the maggots had changed to brown pupæ in the stem, occupying the same place as the larvæ had done (fig. *y*; and No. 35, fig. 9; 10, magnified; 11, the natural length); and on the 20th of July I found two little black flies, the *Oscinis vastator* (fig. 11; and No. 35, fig. 12; 13, flying and magnified) dead in the box, and precisely the same as that bred on the 5th of July, with the empty cocoons also.

No. 35.



Owing to a variation in the nervures of the wings, and other minor differences, this species and many others* have been separated from *Chlorops*, and are raised to a genus bearing the name of OSCINIS; and as our species does not agree with any of the others published in the works of Meigen or

* See Curtis's *Guide*, Genus 1345, species 28 to 61.

Macquart, and I have no opportunity of ascertaining if it be the one described by Olivier, I am compelled to give it a name which alludes to its destructive nature.

O. vastator, Curt. (Plate H, fig. 11); *Tephritis hordei*, Oliv.?—Shining greenish black: antennæ attached to the forehead, short, compressed, drooping, and approximating at the base; four-jointed, basal joint cup-shaped, second semi-orbicular, on the outside of which, near the base, is inserted the third joint, which is exceedingly minute, fourth a short pubescent bristle; lip and palpi concealed in a cavity beneath the head, which is bristly, with a large shining triangular space on the crown, on which are placed the three minute ocelli in a triangle; face smooth, and not concave as in *Chlorops;* eyes remote in both sexes, lateral and oval, brown after death, but probably green when alive; thorax as broad as the head, globose quadrate, with a scarcely visible ochreous pile, forming very indistinct lines in perfect specimens, and an impression on the disk; scutellum semi-ovate, terminated by two bristles, and finely rugose; abdomen short, not so broad as the thorax, rather depressed, ovate conic and five-jointed; wings decumbent in repose, and extending considerably beyond the tail, transparent and iridescent, but slightly smoky; the costal nervure extending beyond the submarginal one to the mediastinal nervure (fig. 11, *n*); all the nervures are pitchy, the two transverse ones are not very remote; balancers with an oval ochreous club; legs six, longish and slender, base and tips of the four anterior tibiæ ferruginous; the base of the first joint, in all the tarsi, is of the same colour: length, ¾ line; breadth, 2 lines (fig. 11; *r*, the same magnified). Some specimens are smaller and more slender; possibly they are the males.

This appears to be a much more formidable enemy than the *Chlorops tæniopus*, for the ten or twelve stalks I opened were filled only with powder at the base, every portion of the young ear being consumed; indeed the destruction was complete.

Let us now pause for a moment, and reflect upon the extraordinary fact, that our corn, the staff of life, is placed in the power of this pigmy race; and that, destined as man is to earn his bread by the sweat of his brow, yet famine, accompanied by its concomitants, disease and death, may overtake him, notwithstanding his industry, and let his prospects be ever so promising, through the united operations of the insect race. How wonderfully displayed, therefore, are the wisdom and goodness of the Creator, in so nicely balancing the destroyer and his parasitic enemies as to keep man, naturally prone to indolence, ever on the alert; and yet, when the countless hordes of noxious insects fall like an irresistible plague upon his crops, that hand which is ever ready to befriend mankind arrests the scourge. Myriads of parasitic insects are let loose, multiplying as their prey increases—the threatening calamity passes over with less severity than could have been anticipated, and the succeeding year, to the astonishment of the farmer, instead of the mischief being increased, not an insect enemy is to be seen.

I may now be permitted to show, with regard to these little flies, the way in which the Creator himself has devised the means of arresting their multiplication. In rearing the *Chlorops* and *Oscinis* I often found that even more parasites than legitimate flies issued from the infested stems, and their history I shall forthwith relate.

I bred a kind of ichneumon from the Canada wheat, which suffered from the maggots of the *Chlorops* in 1841, and the grower of it transmitted another specimen. Likewise on opening the spikes of barley from Sarsden, in October, I invariably found, on the inside of the inner spathe inclosing the incipient ear, an empty pupa case, from 1 to 3 inches from the base, which had either produced the fly (*Chlorops tæniopus*), or this ichneumon, called *Cœlinius*,* one of which stuck in the hole it had eaten with its strong jaws,† owing, in all probability, to the plants having been kept too dry. This parasite was first noticed and described by Olivier, and Dr. Herpin obtained it in such abundance that he states the number of parasites to have been almost as considerable as that of the *Chlorops;* and from my experience I am of the same opinion as to their numerical force. He also says that both broods of the *Chlorops* are equally subject to the attacks of the parasitic *Cœlinius*, which usually hatches many days before the *Chlorops*, especially the males.

With the egg and maggot of the *Cœlinius* I am unacquainted—indeed, the former must be too minute to be visible with the naked eye—but in all probability it is inserted into the maggot of the *Chlorops*, and feeds upon its fat until it changes to a pupa, which I found placed in the groove of the wheat stem (Plate H, fig. 5, a; fig. b being the same magnified, and No. 34, fig. 5, a). A little above this pupa I observed a round hole (c) in some of the spathes, through which the parasites had made their exit; and it is worthy of remark that their wings are perfectly developed and ready for flight before they sally forth, whereas the *Chlorops* comes out with soft imperfect wings, which it is necessary to expand and dry in the open air.

This parasite, like most of those described in former chapters, belongs to the order HYMENOPTERA, family ICHNEUMONIDES ADSCITI, and the genus

* This is the genus *Chænon* of my works; but Nees ab Essenbeck having previously characterized the group under the above name, mine is superseded. I should not have referred my insect to Nees's genus had not Mr. Haliday, in his *Monograph*, been satisfied of their identity; because Nees says the maxillary palpi are five-jointed, whereas they are undoubtedly six-jointed in the specimens of *Chænon* I have examined and figured. See Curtis's *Brit. Ent.*, fol. and Plate 289, fig. 4.

† Ibid., figs. 1* and 3.

Cœlinius.* Olivier also described it under the name of *Alysia nigra;* and Guérin, to pay a compliment to that distinguished naturalist, named it *Alysia Olivierii.*† It is undoubtedly the *Chænon affinis* of my work, which is synonymous with Nees ab Essenbeck's *Cœlinius niger,*‡ and accidentally accords with Olivier's name, which has the right of priority.

19. *C. niger* (fig. 15; and No. 34, fig. 7).—Reddish brown or piceous: antennæ, head, and thorax shining black; the former as long as the animal, slender, and composed of numerous subquadrate joints, basal joint most robust, third the largest; the head is globose-quadrate; face convex; the mouth is furnished with a pair of divaricating jaws, terminated by four unequal teeth; the four feelers are long, especially the maxillary; the eyes are remote and lateral; ocelli three, large, and forming a triangle on the crown; thorax very much elongated, and not broader than the head; post-scutel large, semi-orbicular, and coarsely punctured; abdomen as long as the head and thorax, and broader at the middle, pale piceous, the basal segments very much narrowed, rugose, and brown, the others forming an elongate ovate body; ovipositor scarcely visible; wings rather long, transparent, and iridescent; superior ample, with one marginal, two submarginal, and two discoidal cells; stigma elongate ovate, and brown, as well as the nervures; inferior wings much smaller, the nervures dark and distinct; legs very slender, hinder the longest, anterior ochreous; tarsi fuscous; hinder trochanters and thighs with an ochreous ring at their union: length, 2¼ lines; expanse, 3¾ lines. (Fig. 16; and No. 34, fig. 8, magnified).

All the species of this parasite, of which there are twelve described in the *British Entomology,* inhabit moist meadows, and are principally found from the end of June to September, which is strong evidence that many of the *Chlorops* are bred from the stems of grasses.

Another parasite I bred also from the same stems of wheat and barley, which is an exquisitely beautiful little creature in form and colour. This had been likewise described by Olivier,§ and M. Guérin found some specimens in the bottle containing the corn which produced the *Chlorops Herpinii* and the above *Cœlinius.* On the 11th of August, 1844, and again on the 20th, I found a male of this *Pteromalus,* which had been bred from a stem of the gouty barley from Sarsden; and I soon discovered a little hole, about ¾ inch from the base, through which it had emerged (fig. 5, d). At the base of another abortive ear within the spathe, I found a second specimen of the

* Curtis's *Guide,* Genus 562.

† *Notice sur quelques Insectes Nuisibles,* p. 26, and Plate 4, figs. 1 and 2.

‡ *Hymenopterorum Ichn. affinis Monog.,* vol. i. p. 10.

§ Oliv., *Mém. Soc. d'Agr.,* vol. xvi. p. 477, Plate 3, fig. 12.

Pteromalus dead, and not a vestige of a pupa case, showing that this parasite is very different in its economy to the *Cœlinius*, and lays its eggs in the maggots of the *Chlorops* at such an early period that they are devoured before they have time to change to pupæ, so that there was nothing remaining in the cavity of the stem but the excrement of the *Chlorops'* maggot. It is, however, the opinion of some naturalists that this family of insects destroys the true parasites by puncturing their pupæ.

In a former chapter I described and figured a little fly which was parasitic in the pupæ of the "White Cabbage-butterfly." * The parasite of the *Chlorops* is closely allied to it, consequently it is of the same order HYMENOPTERA, the family CYNIPIDÆ or CHALCIDIDÆ, and the genus PTEROMALUS, of which my genus *Colax* forms a section. † It was named, apparently by Olivier, *Chalcis micans;* and is closely allied to, if it be not identical with Mr. F. Walker's *Pteromalus bellus.* ‡

20. *P. micans*, the Glittering Pteromalus (fig. 17; and No. 34, fig. 9).—Head and thorax of a lovely green, more or less tinged with blue or yellow, and exquisitely shagreened; the former is large and transverse; the face more orbicular; on each side is a dark oval eye, and on the crown three ocelli in the form of a triangle; antennæ nearly as long as the head and thorax, inserted in the middle of the face, filiform, flail-shaped, hairy and brown, composed of thirteen joints, the first being long and naked, and forming an angle with the following, second pear-shaped, third and fourth like little rings, six following oblong, the remainder forming an elongated conical compressed club; mouth with two denticulated jaws, four palpi, &c.; § thorax not so broad as the head, but thrice as long, and oblong; scutellum large, rounded, and convex; abdomen black, smooth, and shining; the base and sides metallic green; the back violet, not so long as the thorax, strap-shaped, concave above, narrowed at the base, the apex pointed; four wings transparent, iridescent, and pubescent; superior ample, with a subcostal brown nervure extending to the middle, where it becomes the costal nervure, but does not reach the tip, and beyond the middle is a short clavate branch; inferior wings much smaller, and nerveless, excepting a short subcostal one; six legs, slender, and bright ochreous; coxæ bright green, hinder stout; thighs pitchy, anterior with the apex and a stripe beneath ochreous, the others tipped with ochre; tarsi five-jointed, anterior often dusky, the others, with the fifth joint, the pulvilli, and claws, black: length, 1½ line; expanse nearly 3 lines. (Fig. 18, the male, magnified.)

Such is the description of the male; and it is a little remarkable that the

* Chapter iv., page 100, and No. 13, figs. 5 and 6. † See Curtis's *Brit. Entom.*, fol. 166.

‡ Curtis's *Guide*, Gen. 627. No. 104. § For the dissections, see Curtis's *Brit. Ent.*, Plate 166.

female seems to be unknown, all the bred specimens being of the former sex.* There are probably 700 or 800 *species* of these insects which have been described as inhabitants of Great Britain,† their increase is prodigious, as already shown in Chapter IV., and there is scarcely a blade of grass, during the summer months, that is not ornamented with these beautiful little creatures—

"The green myriads in the peopled grass"—

which may compete with the humming-birds in the brilliancy of their colours.

From the stems of barley containing the pupæ of the *Oscinis vastator*, I bred a third parasite, much smaller than either of the foregoing, and found many more upon the windows of my room, where the plants were placed, which, no doubt, had escaped. They were all females, belonging to the order HYMENOPTERA, family ICHNEUMONIDES ADSCITI or ALYSIIDÆ, the genus SIGALPHUS, and have been named by Nees ab Essenbeck ‡—

21. *S. caudatus*, from the length of the tail (fig. 19; and No. 35, fig. 14).§—It is black and shining, indistinctly punctured; the head is subglobose, with two lateral eyes, and three minute ocelli on the crown; the antennæ are as long as the body, flail-shaped, slender, and filiform, composed of twenty or twenty-one joints, basal one the longest; thorax oval and gibbose, the sutures very deep; abdomen broader than the thorax, and rather longer, elliptic ovate, with three equal segments, the two first and the base of the third finely striated longitudinally; the apex polished; belly concave; ovipositor exserted, and longer than the animal, composed of an oviduct and two sheaths; wings four, transparent, iridescent; marginal cell ovate, submarginal subovate; discoidal cells two, superior the largest, rhomboidal, inferior oblong; nervures piceous, as well as the stigma, which is large and elongate ovate; legs pitchy; anterior ferruginous, excepting the base of the thighs and the tarsi, base of the other tibiæ ferruginous: length from ⅘ to 1 line, without the ovipositor; expanse, 1⅘ to 2¼ lines. (Fig. 20; and No. 35, fig. 15, the female magnified.)

As Dr. Herpin seems to have ascertained the economy of this parasite, or a closely allied species, during its early stages, I shall transcribe his sensible observations:—"An ichneumon, of which the female is armed with a long ovipositor, perforates the shell of the *Chlorops'* egg, and deposits there its own. The young larva of the *Chlorops* of the wheat grows and increases,

* Since the above account was written, the female has been identified, and is figured in No. 34, fig. 10, magnified.

† Walker, in the *Entomological Magazine* and his *Monographs*.

‡ *Hymenop. Ichn. affinis Monog.*, vol. i. p. 268.

§ Figs. 1, 2, 3, and 4 of the above wood-cut, refer to *Oscinis granarius*, which will be described in a future chapter.

although it incloses in its body a mortal enemy. The larva of the parasite grows and flourishes with its victim, and she nourishes herself with its fatty substance; but, how admirable! the parasite never attacks any of the essential organs of life in the *Chlorops*, for if this happened to perish, the parasite would infallibly die with it. After the diseased *Chlorops* has metamorphosed to a chrysalis, the parasite finishes by destroying it entirely; and one sees with surprise an insect come out of the pupa of the *Chlorops*, not the destructive fly of the wheat, but an ichneumon, which in its turn proceeds again to persecute the progenitor of the corn-destroying *Chlorops*."

Having now completed the history of the instruments provided by Providence to check the ravages of the *Chlorops*, we will turn to those means suggested by the experience of man; and here again I shall translate a portion of Dr. Herpin's memoir:—

"In the years when the *Chlorops* exists in great quantities, the means to destroy it consist in pulling up, carrying away, and burning the plants which are attacked by them, as well of the first as the second laying.

"The first operation can be done at the time of weeding or of clearing the corn of thistles: the young swelled and yellow plants are easily enough known. The second operation ought to be performed a fortnight or three weeks before harvest time, when it is much more easy to execute, as the stems attacked by the *Chlorops* are very easily distinguished, even at a distance, because of their short height, more considerable thickness, and deep green colour of the head; and, lastly, because the ear always remains sheathed and enveloped by large leaves. Moreover, these plants thus altered are almost always found situated at the lower side of the beds or furrows, so that in passing between two ridges one can easily reach them with the hand, from one side or the other, without causing any damage to the corn.

"Another of the most certain means, the most economical, and the most advantageous, which can in general be employed to destroy the insects injurious to our crops, is to vary the culture by alternate courses, so that corn crops may be succeeded by others which are weeded or fed off, and *vice versâ*. It will follow that the noxious larvæ deposited in the fields, not finding at the period of their hatching the nourishment which is suited to their organization, are not able to subsist, and infallibly perish."*

He is also disposed to attribute the apparent exhaustion of the soil from over-cropping, as much to the presence of, and the excessive propagation of certain injurious insects as to the land being actually tired; and thus the rotation and changing of culture, whenever they are not called for by other

* Herpin's *Memoir*, pp. 11 and 12.

powerful reasons, ought yet to be adopted and put in practice, to hinder and prevent the too great multiplication of certain species of noxious insects.

Mr. Arthur says, "Perhaps the most efficient preventive would be to detect the insect fly when it appears to deposit its eggs, and keep it from lighting on the field by the application of some repulsive perfume, such as soot, guano, or sand that has been immersed in gas-water, &c., dried and sown over the field." *

As the larvæ of these flies have caused considerable alarm on many occasions, and have no doubt done extensive mischief, we will take a general review of their economy before we dismiss the subject. It is now evident that there are many species of these flies to whose larvæ wheat, barley, and rye are equally acceptable, and we cannot be certain that they are not bred in grasses also; indeed, from the swarms of the *Chlorops'* fly that are found in meadows, and the myriads that enter dwelling-houses, often not surrounded by corn fields, it seems to be very probable. There are also, it will be observed, two broods of the *Chlorops* annually; the maggots of one attacking the corn when the ear is formed, but yet concealed in the sheath, doing the greatest mischief in some instances, for not only are the ears not ripe at harvest time, but they are either abortive or the grains are shrivelled and worthless, and what is equally detrimental, the lateral shoots are rendered useless, owing to the advanced period of the season. The following, or second brood deposits its eggs in the autumn-sown corn as late probably as the middle of October, in open weather. It is true that from the attacks of this brood the central shoot perishes in the spring. This, however, only retards the growth a little; for the lateral shoots being strengthened, and having time to grow and produce ears, it appears that in some instances little or no bad consequences followed; and it may be that even a more abundant crop has been produced under such circumstances.

It is deserving of notice that white wheats are most palatable to these larvæ, and, I believe, are generally preferred by noxious insects. When, therefore, it is stated that the *Chlorops* sometimes prefers rye and barley to wheat, it may be owing to its being red wheat, but at present this has not been substantiated.

Of the two species belonging to the genus *Oscinis*, there seems to be no evidence of their producing two broods in a year. The larvæ of the Swedish species (*O. pumilionis*) were small at the end of April, they changed to pupæ at the end of May, and the flies were produced in the middle and end of June. Our British species (*O. vastator*) was found in the larva state in May

* *Gardeners' Chronicle* for 1844, p. 365.

and June, towards midsummer the maggots changed to pupæ, and the flies were hatching, during three weeks or upwards, in July. This is decidedly the most destructive species that has fallen in our way.

With regard to the successive transformations of these insects, it is positively stated that the *eggs* are laid at the base of the leaves which sheathe the ear, by the first or summer brood, and it may be presumed that the autumnal eggs are similarly deposited. To detect and destroy such atoms is impossible: the only remedy at this period would be to anticipate the female flies, and kill them. Whether it would be possible to attract the flies to any spot by white painted boards, or any liquor that would poison them, has not been ascertained. To drive the flies away by ammonia, gas-water, or other vapours, I should not think feasible; but I doubt not that dusting the young corn plants with soot or lime, on the first intimation of the fly in the autumn, would prevent the deposition of the eggs.

The *maggots* or larvæ of the summer brood live between the stem and the sheath above ground: those of the autumnal brood appear to be close to, if not below, the surface. The former could not be affected by any application, I should imagine; but strong liquid manures possibly might annoy the others. Hard frosts, however, are in all probability one of the greatest checks to the perfecting of these larvæ.

The next is the *pupa* or chrysalis state, which the larvæ assume about the end of March and in July, when the sickly plants are easily discovered, and may be pulled up, and should be burned immediately, unless there is a prospect of the spring corn throwing out lateral shoots, and producing, as Mr. Marwick's did, an abundant crop. I have now only to observe, that as neither the eggs, larvæ, nor pupæ are deposited in the earth, of course no ploughing or harrowing can be of the least service; and as the injury, although it may be occasionally alarming, is not followed by any succession of continued attacks, the mischief caused by them hitherto appears to have been only temporary.

SUMMARY OF THE FOREGOING CHAPTER.

The *larvæ* of some *minute beetle* destroying the green wheat in 1802.

One-fifth part of the wheat sown destroyed by them.

Wireworms occasioned an annual loss of 60,000 bushels of seed.

Larva, probably, of a ground-beetle, or *Carabus*, feeding on the roots of corn.

Zabrus gibbus, a ground-beetle which devours the soft grains of wheat in standing corn.

The *female* lays her *eggs* in clusters in the earth.

The *larvæ* burrow in the earth, and do great mischief by eating into the stem, sometimes destroying two successive crops of *wheat* in Germany and Italy.

They also attack *rye* and *barley*.

Both the *larvæ* and perfect insects feed by *night*, and lie concealed during the day.

Poultry and *crows* will clear the land after ploughing.

Peat-ashes are an excellent dressing for infested lands in the spring.

Harpalus ruficornis, another ground-beetle, in abundance on *wheat ears* at night.

The *field-chaffer* feeds upon the soft *grain* of rye and wheat.

It is not known if their *larvæ* attack the roots of corn.

May-bugs abundant in corn fields, feeding on leaves and flowers. Do they injure the corn?

Their *larvæ* consume the roots of *grasses*.

A *caterpillar* which feeds upon the grains of wheat in the *field*, as well as in the *barn*. It also lives upon the seeds of grasses.

These *larvæ* destroyed *one-third* of the produce occasionally.

Noxious insects often appear simultaneously over a great extent of country.

These *caterpillars* will attack and *destroy each other* in confinement.

Repeated ploughings recommended to destroy the pupæ; but as the caterpillars are conveyed away with the corn, that would be useless.

The "*Pale Mottled Willow-moth*" is the parent of this caterpillar, and is abundant in hay fields, &c.

Caterpillar of a *saw-fly*, found on wheat ears amongst standing corn.

Musca pumilionis, the larva very destructive to rye.

The *diseased stems* should be collected and *burned*. One person could collect some thousands in a day.

The same or an allied species attacked the *wheat* near Battle.

The *central shoot* being destroyed, lateral branches were thrown out, and *a good crop* was obtained.

The *September* and *October* sown *wheats* only affected, and the *red wheat* nearly escaped.

In 1812, the *Society of Agriculture* of the Seine was officially consulted by the minister of the interior, regarding the ravages in France occasioned by the larvæ of *Chlorops lineata*.

The *larvæ destroyed* the central leaves and the *plant* itself.

When the wheat begins to show the ear early in June, the *female* lays her *eggs* on the stems.

The *eggs hatch* in a fortnight, and the maggot eats away below the base of the ear.

It is transformed to a *pupa* towards the first superior knot.

The *Chlorops hatches* in September, and then lays her eggs on the rye and recently sown corn.

The infested *corn is stunted* and green whilst the healthy plants are ripe, the ears are not liberated, and the grains are diminutive or quite abortive.

In 1840, the *loss* was estimated at *one-seventieth part* of the harvest, besides the number of young plants that had been destroyed at an earlier period.

Chlorops Herpinii attacks the ears of barley—from six to ten being found in each; and by destroying the flowers they render the ears sterile.

Musca frit. inhabits the husks of the *barley*, and destroys one-tenth of the grain.

Linnæus calculated the annual *loss* in Sweden at *one hundred thousand pounds* sterling.

Chlorops tæniopus attacked some transplanted wheat.

The *larvæ feed singly* from the first joint to the base of the embryo ear or higher.

In *August* the *flies hatched.*

They *attacked barley* also at an earlier period.

It attacked also some naked *barley* from *Nepaul.*

A species of *Chlorops* occasionally swarms in *dwelling-houses.*

They were in abundance in a *wheat stack* in April, and destroyed many acres of *rye.*

Another species attacked the *wheat fields* in May.

The *larvæ* entered 2 inches beneath the surface, destroying the *internal stalk.*

Other fields of *wheat,* sown in *February* and *March,* were subject to the same disease.

These maggots produced in July a new species of fly, the *Oscinis vastator.*

This, from its operations, appeared to be the *most destructive* of the species.

They are kept in check by *parasites.*

One, a kind of ichneumon, named *Cœlinius niger,* feeds in the body of the maggots, and is frequently very abundant.

Another, called *Pteromalus micans,* lives in the maggots also, and destroys them before they change to pupæ.

A third parasite, the *Sigalphus caudatus,* was bred from the pupæ of *Oscinis vastator.*

It is said to deposit its *eggs* in those of the *Oscinis*.

Dr. Herpin recommends *pulling up and burning* the infested plants, which may first be done when weeding is going on, and, subsequently, two or three weeks before harvest, when their size and colour readily distinguish them.

Rotation of crops one of the best means of keeping free from noxious insects.

Over-cropped land refuses to bear, perhaps as much from diseases caused by an excessive increase of insects in the soil, as from exhaustion.

Soot and sand saturated with gas-water, sown over a field, might keep off the *Chlorops*.

It is not improbable that some species of *Chlorops* breed in the stems of *grasses*.

There are *two broods* of the *maggots* in a year, the first living in the spring, the latter through the winter, in some instances.

The *first brood* destroys the ear, the *second* the central shoot, after which lateral shoots are sometimes matured.

It is doubtful if the species of *Oscinis* produce two broods annually.

The *O. vastator* is by far the most formidable enemy.

Is it possible to *attract the flies* by white painted boards or poisonous liquids?

Dusting the young corn with *soot or lime* would drive away the flies.

Strong *liquid manures* would annoy those broods which reside in the young corn plants.

Do not pull up the infested corn plants in the *spring*, if they attempt to throw out lateral shoots.

Ploughing and harrowing of no use, as neither the eggs, pupæ, nor larvæ inhabit the earth.

EXPLANATION OF PLATE H.

Fig. 1. *Chlorops tæniopus.*
Fig. 2.* The same magnified.
n, The termination of the costal nervure.
*l**, One of the antennæ or horns.
Fig. 3.* The head in profile.
m, The concave face.
Fig. 4. The fly in repose.
Fig. 5. The *lower portion* of a wheat stem.
o, The pupa of *Chlorops tæniopus, in situ.*
Fig. 6.* The same magnified.
Fig. 5. a, Pupa case from which *Cœlinius niger* hatched.
b*, The same magnified.
c, The hole from which the *Cœlinius* escaped.
d, The hole from whence the *Pteromalus* made its exit.

Fig. 7. A wheat plant as it appeared on the 7th of June.
Fig. 8. Larva of a *Chlorops*.
Fig. 9.* The same magnified.
Fig. 10. The pupa case *in situ*.
q*, The same magnified.
Fig. 11. *Oscinis vastator*, Curtis.
r*, The same magnified.
n, The termination of the costal nervure.
Fig. 12. Corn plant as it appeared on the 23d of June.
s, The green outer leaf.
t, The inner yellow one.
Fig. 13. The same plant opened.
u, The base of the stem eaten through.
Fig. 14. The interior of the stem exposed.
v, A slender brown portion of the stalk left by the larva.
w, The larva feeding.
x*, The same magnified.
y, The pupa in the stem.
z*, The same magnified.
Fig. 15. *Cœlinius niger*, a parasite.
Fig. 16.* The same magnified.
Fig. 17. *Pteromalus micans*, a parasite.
Fig. 18.* The same magnified.
Fig. 19. *Sigalphus caudatus*. a parasite.
Fig. 20.* The same magnified.

Wherever lines accompany the objects in the plates, they denote the natural dimensions; and those numbers and letters with a * attached, refer to the objects that are represented much larger than life. All the figures are drawn from nature.

CHAPTER IX.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE CORN CROPS; INCLUDING A SAW-FLY, THE HESSIAN FLY, THE WHEAT-MIDGE, AND THE BARLEY-MIDGE.

CEPHUS PYGMÆUS—*the Corn Saw-fly.*

IN continuation of this subject from the last chapter, I shall proceed with the histories of those insects which infest the corn, and amongst them is one that is very abundant in this country, and with which I am well acquainted in its perfect state, having for many years observed the flies in corn fields, occasionally in great abundance: yet I have never heard of its economy having fallen under the observation of any English naturalist or cultivator; and it is to the diligence and science of our continental neighbours that we owe the knowledge we possess of the habits of this interesting species.

It is, however, by no means a recent discovery, for in 1819 M. Dugaigneau, a skilful agriculturist of the department of the Loire, made known the metamorphoses of this species, and the changes it produced in the wheat.* In his memoir he says, that having pulled up a quantity of the roots of rye at harvest time, he found some white larvæ of a *Sirex* (Plate I., and No. 36, figs. 1) in the stubble. After the severe winter of 1812–13, he wished to see if the larvæ had perished. He therefore collected some stubble and found them alive: they had not at all suffered, for at the end of March a great many were transformed into pupæ, and many had hatched in the beginning of April.†

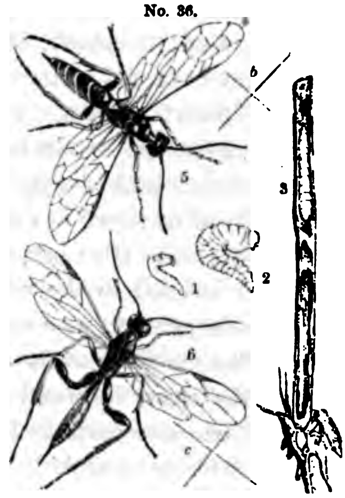
"The insect," says M. Dugaigneau, "after pairing, pierces the stalk of the rye, below the first knot, to deposit an egg in its interior, which hatches so much the earlier, being warmed by the sun's rays concentrated close to the earth, amongst all the straw of the rye. The little larvæ live upon the interior of the straw, which is then very tender, and upon the nutritive juices of the sap, which ought to form the grains in the ear. It soon acquires sufficient power to be able to perforate the knot in the straw, it then

* *Annales de la Soc. des Sciences. Belles-Lettres et Arts d'Orleans*, vol. i. p. 121.

† *Notice sur quelques Insectes nuisible au froment*, &c., p. 34.

passes through and ascends to a greater or lesser height in the interior—I have found a few which had surmounted all the knots; the larva afterwards descends, and arrives at the base of the straw when it has attained its full growth; it then cuts down the straw level with the ground, before and even at the moment the grain is matured; it sometimes happens that it is not entirely sawed through at harvest time."*

No. 36.



It then descends into the stump of the rye, a little below the soil, where it closes its tunnel with a stopper of sawdust and excrement; it then incloses itself with a transparent covering a great deal larger than itself, in which it rests eight months (figs. 3). M. Dugaigneau has observed this larva also in the wheat straw, but it is rare there.

M. Herpin, who has likewise investigated the subject, says,† "If you traverse a field of wheat or rye, a week or fortnight before harvest, you may observe a greater or less considerable number of stems, the straight and whitened ears of which elevate themselves above the others, and appear to have attained their perfect maturity. They form a striking contrast with the neighbouring plants, which are still very green; and the heavy ears filled with grains are inflexed and bent towards the earth, whilst the others are entirely empty, or contain only a very small number of grains, which are for the most part shrunk and horny.

"On carefully opening or splitting longitudinally the stubble or the stalk bearing the erect and bleached ears, of which I have just spoken, you will remark, first, that it contains a yellowish powdery detritus, formed by the debris of the plant which has been eaten internally; secondly, that the knots of the straw are perforated in the interior of the pipe of the stalk; thirdly, that one finds a little above one of the knots a larva occupied in eating the medullary partition of the plant.

"This larva, of a white colour, has six rudimentary feet (figs. 1; figs. 2, the same magnified); its length varying from 3 to 15 millimètres (that is, from a line to more than half an inch), according to its age; its head, rounded, hemispherical, brown, and like horn, is armed with strong mandibles. One finds this larva at the commencement of June; it is placed in the inside of

* *Annales d'Orleans.*

† *Mémoire sur divers Insectes nuisibles à l'Agriculture,* par J. Ch. Herpin.

the stalk, lower down and nearer to the earth as it becomes older, and as the maturity of the plant is more advanced. Finally, some days before harvest time, this larva retreats nearer to the roots of the plant; it constructs, inside of the straw, a silken transparent case (figs. 3; fig. 4, the same magnified), in which it shuts itself up and passes the winter; after, however, having taken the precaution to cut the straw circularly on the inside, about 28 or 14 millimètres from the earth, so that the perfect insect may find no difficulty in issuing from its prison. In consequence of this section, the straw, having no more sustenance, breaks off at the foot and falls to the ground when the wind becomes a little strong; the field then presents the same appearance as if it had been traversed in every direction by sportsmen or by animals.

"A long time after harvest, and even during winter, we may still find the larvæ inclosed in the roots of the stubble; to be satisfied of this, it is only necessary to pull up a number of the pieces of straw left adhering to the roots. Those which contain a larva are detached with the greatest facility, because the straw is sawed circularly, as already stated. By looking with attention, one also finds at the same period, quite close to the earth, some very short pieces of stubble, cut very horizontally, which contain the insect. Towards the end of May, or when the wheat and rye begin to ear and before the flowering, the larvæ metamorphose and give birth to a fly (figs. 5). These flies distribute themselves over the fields sown with wheat or rye, and deposit an egg upon the stem of the corn immediately below the ear."

This group of insects is interesting to the naturalist, as it forms the transition from the saw-flies to a family named SIRICIDÆ.* Like all such insects, it belongs to the order HYMENOPTERA, the family TENTHREDINIDÆ, and the genus CEPHUS of Latreille; and the species before us was named SIREX PYGMÆUS by Linnæus, from its being much smaller in size than the other individuals with which he associated it.

1. *Cephus pygmæus* is of a shining black colour; the head is rather large, with prominent eyes, and three minute ocelli on the crown; the antennæ are inserted in front of the face, they are tolerably long and slender, but slightly clavate, and composed of twenty-one joints; the basal joint is ovate, the second minute, six following elongated, the remainder very much shorter, the apex being oval; the mouth in the male is bright yellow, including the powerful jaws,† on the clypeus is a spot of the same colour, and the interior margin of the eyes is likewise yellow; the thorax is oval, and not broader than the head; the abdomen is sessile or attached by its entire base, rather long, slender, and slightly compressed; at the base is a yellow membranous

* See Curtis's *British Entomology*, fol. and Plates 253 and 460. † Ibid. Plate 301.

spot, there are yellow spots on each side of the first and second segments, and a dot on the back of the latter, the third and fifth segments have broad yellow margins, the sixth has a narrow one, forming spots on the sides and back, and the apex is yellow; the four wings are transparent and iridescent, there are two marginal and four submarginal cells in the superior, the costa and stigma are yellowish brown, and all the nervures are brown and slender; the legs are bright yellow, including the coxæ and trochanters, but they, as well as the thighs, have black stripes on the outside; the hinder tibiæ have a pair of spurs on the inside below the middle, and also at the apex, they are brown on the inside, as well as the tarsi, which are five-jointed; the claws are bifid at their tips, with little pulvilli between them. The *female* is darker, the palpi and sides of the jaws only are yellow; the abdomen is rather stouter and shorter, the yellow spots on the two basal joints are either very minute or absent, and the margin of the sixth is less apparent, and the bands are more of a sulphur colour; the apex is sloped off obliquely, and incloses a black ovipositor, which is but slightly exposed; the wings are rather smoky; the legs are ochreous, the coxæ, trochanters, and thighs black, excepting the apex of the latter above; the hinder tibiæ are brown inside, and the four posterior tarsi are of the same colour: figs. 5; the cross lines showing the natural size.

This saw-fly is very abundant, annually, on flowers in corn fields in June, also on grass in woods; and I remember finding vast numbers of the females upon white umbellate flowers growing by the roadsides near Dover, in the beginning of July, but I could not detect one male.

The larva is not less interesting, in a scientific point of view, than the imago; for, being an apode—that is, destitute of feet—it is unlike those of the saw-flies, which, it will be remembered, have frequently a great number of legs, and resemble caterpillars more than maggots.* The following is M. Herpin's description of the larva of *Cephus pygmæus*:—It is 6 lines long, a little thickened anteriorly, nearly cylindrical, of a yellowish milky white, and tolerably fleshy: its head is rounded, corneous, and ferruginous: there is a minute four-jointed antenna on each side, below which is a little round eye: the three thoracic segments have no feet, but each has two nipples beneath; the last segment is terminated by a little tubular appendage, which is capable of being protruded like a telescope, and assists the insect in its progress within the tube of the straw to which it is confined: figs. 1; figs. 2, magnified.

The *pupa* (?) as represented in Guérin's plate, appears to be cylindrical, and

* See the caterpillars of the turnip saw-fly, Plate B, chap. ii.

composed of nine segments, tapering towards the tail and thickened at the opposite extremity: it is inclosed in a transparent cylindrical cocoon, about five lines long, rounded at one end and stopped irregularly at the other with an operculum of excrement, &c.: figs. 3; fig. 4, magnified.*

In the department of the Charente, on the western coast of France, this insect, to which the people have given the name of "aiguillonier," † has occasioned very great ravages amongst the standing corn, causing a considerable loss to the cultivators. Similar losses have been sustained in Africa by the colonists, whose corn was attacked in the same way, and the mischief being absolutely of the same nature. M. Herpin thinks it was the operation of the same or an allied species. "The damage," he continues, "done by the *Cephus* to the wheat and rye, in the locality ‡ where I have observed this insect, is serious enough, since the ears produced by the attacked stalks are generally sterile, or contain only a very small number of grains, and I estimate the damage at about one-sixtieth of the whole crop; but that which it caused in Africa and the Charente appeared to be much more considerable."

To destroy this troublesome pest, M. Dugaigneau proposes ploughing in March or the beginning of April. He thinks that the turning over and burying the stubble in the ground would destroy the larvæ as well as the perfect insects, which would not be able to penetrate the soil in order to get out at the period of their hatching; on the other hand, M. Herpin says the best means of destruction appears to be to set fire to the stubble which remains upon the field after harvest, as the larvæ are inclosed close to the roots: he also adds, that all well-informed agriculturists know that the burning of the straw to ashes is one of the most active and economical stimulants of vegetation, especially in strong and argillaceous earths, which the fire dries and calcines; they are ameliorated and improved at all times by this simple operation, which is so easy and costs nothing to execute. §

Providence has also provided a remedy in a parasitic ichneumon (figs. 6), which is actively engaged in our corn fields in the destruction of the larvæ of the *Cephus*, with which it has been found inclosed; and the parent fly must be endowed with a surprising intelligence, for, as M. Dagonet justly observes, the deposition of the egg "is an operation difficult enough, if one reflect that the ichneumon has not only, like the greater number of the *Pupivoræ* (or pupæ-destroyers), to touch the skin of the larva but lightly, on which its progeny must be supported, but it has at first to satisfy itself of

* It appears to me that M. Guérin's figure exhibits the larva in its case, and not the pupa, which I have never detected.

† M. Herpin suspected it was the larva of the *Cephus*, and his opinion has been confirmed by M. le Comte de Tristan.

‡ Metz on the Moselle, in France.

§ Extract from the *Mémoires de la Soc. Royale et Centrale d'Agriculture*, A.D. 1842.

the exact spot in the stubble where the larva of the *Cephus* is to be found, so that at the same time it pierces the stalk it must reach the larva which is to receive its egg." *

This parasitic fly also belongs to the order HYMENOPTERA, the family ICHNEUMONIDÆ, the genus PACHYMERUS; and the species is named CALCITRATOR by Gravenhorst, in his *Ichneumonologia Europœa.*

2. *P. calcitrator* is about the same size as the *Cephus;* the *male* is black, shining, and pubescent; the head is somewhat globose, but concave at the base; the eyes are rather small and ovate, and there are three minute ocelli on the crown; the palpi are tolerably long and slender; † the antennæ are inserted in front of the face, not so long as the body, slightly thickened towards the apex, and composed of twenty-two joints, the basal one oval, second minute, third elongated, the following decreasing in length, each joint producing a bristle on the inside; they are brown, but yellow beneath: the thorax is narrow and elongated, the postscutel is narrow and elongated: abdomen somewhat spindle-shaped, but clavate, the apex being thickened and compressed; the petiole is long, narrowed, and pitchy, as well as the second joint; the third and fourth are reddish, edged with brown; the remainder are brown, edged with white: the wings are ample, transparent, and iridescent, the stigma and nervures yellowish brown; superior without an areolet, the stigma and marginal cell are elongated, the upper discoidal one has a short internal branch: legs very slender, excepting the hinder, which are long and stout; they are brown, the four anterior are ochreous on the inside; posterior coxæ long, their thighs are thick in both sexes; tibiæ spurred, hinder long, stoutish, and sometimes inclining to reddish brown, especially at the base; tarsi five-jointed, claws and pulvilli minute. The *female* is similar, but the antennæ are shorter, and not pubescent; the abdomen is broader and not compressed; apex of the petiole, as well as the second, third, and fourth segments, reddish, the second generally with a brown patch on the back, the fifth and following segments are black, distinctly edged with white: ovipositor exserted. Figs. 6, the female; the cross lines exhibiting the natural dimensions.

I have taken the female at Coomb Wood, Surrey, and in Dorsetshire, resting on gate-posts, in June, and both sexes in hedges, in Norfolk and Suffolk, and also in the Isle of Wight; the males I have met with at Darent and Dover, early in June; and at the end of July, both sexes have been abundant in the same localities, and also in Battersea Fields, on umbellate flowers. I may here observe, that there are ten or twelve British species of

* *Notices Entomologiques*, p. 40. † Curtis's *British Entomology*, fol. 624[a], and Plate 624.

the interesting genus *Cephus;** and as I find one of them, named *C. tubidus*, in company with *C. pygmæus*, it is not improbable that their economy may be similar. I find that Latreille suspected the larvæ fed on the interior of plants, which he supposed might prove to be the various species of grasses;† and Messrs. Kirby and Spence say, "that upon *barley* particularly you will meet with the species of Latreille's genus *Cephus.*" ‡

There is also a beetle which infests both wheat, barley, and oat crops in the south of France, which we shall only briefly notice, as it is not an inhabitant of this country. It is of the family CERAMBICIDÆ, and has been named

SAPERDA (CALAMOBIUS) MARGINELLUS.

In June, when the corn is in flower, the female beetle introduces an egg into the stem, which hatches in from eight to fourteen days. The larva is then nourished on the interior of the straw, ascending to the ear, afterwards descending to the base, and being full-grown at harvest time, it rests in a cell of detritus stopped at both ends; the following spring it becomes a pupa; after which the beetle soon hatches and feeds on the stamina of the flowers. As much as one-fourth of the crop has been known to be destroyed by this small beetle. §

CECIDOMYIA DESTRUCTOR, Say—*the American Wheat-midge.*

If Köllar be correct, there can no longer be any doubt that the "Hessian Fly" has been detected in Europe. It does not, however, appear to be known in France; and it is now half a century since its supposed introduction into this country caused serious apprehensions among the people, and alarmed the agriculturists of England. || As it is intimately connected with a species which we shall next have to discuss, it may not be unadvisable to give a sketch of its history.

The Americans entertain an idea that this fly was first introduced into their country in straw which accompanied the Hessian troops; whence they have given it the appellation of "Hessian Fly." It has been occasionally a dreadful scourge in North America, for the larvæ have committed such ravages on the wheat crops as to cause even famine in the land. It was not until the autumn of 1833 that this destructive insect, or a species closely allied to it, was observed in Hungary; ¶ whether, from its previous rarity, it had

* Curtis's *British Entomology*, fol. 301; *Guide*, Gen. 476.

† *Hist. Nat.*, vol. xiii. p. 138.

‡ *Introduction to Entomology*, vol. iv. p. 503.

§ See *Annales de la Soc. Ent. de France*, second series, vol. iii. p. lxvi., and vol. v. p. xvii.

|| Mr. Markwick ascertained that the insect which caused such a sensation during the period of scarcity was a *Chlorops*, described in chap. viii p. 230.

¶ Mr. Herrick states in Silliman's *American Journal of Science* (vol. xli. p. 253), that Mr. J. D. Dean discovered the true Hessian fly in Minorca and near Naples.

been overlooked, or had not found its way into the Austrian dominions, is not known. Köllar* states that it appears from a report transmitted to the Archduke Charles, that in the beginning of June the ears of wheat were observed to droop and the straw to bend, on his estates at Altenburg, although the crop was previously in fine condition; in a few days, patches on the poorest soil in different parts became entangled, as if matted together by heavy rains or high winds, which were supposed at first actually to have been the cause. This soon proved to be unfounded; for the mischief gradually spread from the poor to the best lands, until the whole was blighted. Two-thirds of the straw at least was laid in less than a week, and the work of devastation was completed by the heavy fall of rain which took place during the latter part of June. The straw thus prostrated produced only small abortive ears; the few grains they contained were shrivelled, and would scarcely ripen, and the straw was of a very bad quality.

On examining the roots of those plants which had died off, the soft straw where the larvæ had stationed themselves in families within the sheath of the leaf, appeared withered, tough, and brown, yet not wounded: at this period the larvæ were transformed into pupæ, which were found in clusters inside of each leaf-sheath, at the first joint next to the crown of the root.

On the estates of the Duke of Saxe-Coburg, at Weikendorf, and in other parts of that neighbourhood, whole fields were destroyed. The larvæ were found to live in society, forming a sort of nest between the straw and the sheath. They are said to penetrate into the tube of the straw; however that may be, they deprive the stem of the sap, and it consequently withers and dies. The larvæ are of a pale green colour, with a minute black dot above: they do not exceed 2 lines in length; and they live from about three weeks to a month: the pupa is brown and inclosed in a case. It was several weeks before the fly hatched; it is extremely small and delicate, scarcely so large as a common gnat; the body is clothed with short black hairs: the thorax is very convex, smooth, and shining; the scutellum projects, and is rounded behind; the breast being sometimes of a golden yellow colour, the abdomen brownish: the wings are blackish; the deep yellow of the base sometimes extends to the nervures, where it is gradually softened off: the poisers are yellowish white;† the base of the thighs is golden yellow: the *female* has a black streak on the abdomen.

The above descriptions do not agree with Say's;‡ and I see by a para-

* *Naturgeschichte der Schædlichen Insecten*, p. 130; and Köllar's *Treatise on Insects*, p. 119.

† Dr. Asa Fitch affirms that they are dusky in the *true* Hessian fly.

‡ *Journal of the Academy of Natural Sciences of Philadelphia* for 1817, vol. i. p. 45, Plate 3, figs. 1–3.

graph in the *Entomological Transactions*, Mr. Herrick, of New Haven, North America, had informed Mr. Spence that the accounts hitherto published concerning the natural history of the Hessian fly were very erroneous: he considered it to be referable to Meigen's genus *Lasioptera*;* and it is attacked by five parasites, two of which belonged to the genera *Eurytoma* and *Platygaster*. Mr. Spence also observed, at a previous meeting of the Entomological Society, that Dr. Hammerschmidt's *Cecidomyia*, which is the Hungarian one, is specifically distinct from Mr. Kirby's *C. tritici*; and that Say's *C. destructor*, called the Hessian fly, is different from either.† The female of the American species lays in the autumn not more than eight eggs, which are introduced by her ovipositor between the sheath and the stem, close to the base,‡ where the larvæ feed as soon as they hatch, and are said to live through the winter with their heads downward; but the mischief they cause is not discoverable until the wheat is more advanced.

A parasite, called by Mr. Say *Ceraphron destructor*, but which may possibly be a *Pteromalus*, in the opinion of Mr. Westwood, though smaller than the *Cecidomyia*, proves so formidable an enemy, by depositing its eggs in the larvæ, that few of them become pupæ; otherwise, Mr. Say believes that their wheat crops would be totally annihilated. Köllar also found the majority of his pupæ so full of a similar parasite, that he felt convinced the crops would not be attacked by the wheat-midge the following year, which prediction was completely verified. I have been led to give a more extended sketch than I intended of the North American and European "Hessian flies," from my conviction that two species at least have been confounded by Köllar and other writers, owing to their similar economy; and it will be as well to designate our species as—

The British Wheat-midge—CECIDOMYIA TRITICI, Kirby.

The alarm we have already alluded to in the last century produced good effects, by inducing many talented men to investigate the subject in order to allay the public anxiety; and thus, amongst other noxious insects, we obtained the natural history of the wheat-midge, as it is now called. It will now be my object to lay before the reader the leading points of these contributions, so connected as to enable the agriculturist to understand the economy of this destructive little animal, and to supply materials for perfecting its history, as opportunities may offer; for I am satisfied that at a future day these are

* Curtis's *Guide*, Genus 1147. Dr. Harris says it is a true *Cecidomyia*.

† *Transactions of the Entomological Society*, vol. i. p. iv. v.

‡ It is positively stated that the female lays her eggs in the creases of the young leaves of the wheat on the upper surface. See Dr. Harris's *Treatise on Insects*, and Westwood, in *Gardeners' Chronicle*, 1847, p. 604.

subjects which will not be found uninteresting or unprofitable to the agriculturist.

In May, 1796, a paper was read before the Linnean Society by Mr. Marsham, the secretary,* in which he stated that Mr. Long, who farmed land in Hertfordshire, had detected an insect amongst the wheat, towards the end of July, which threatened to do much mischief, attacking from one to several grains in an ear. It was easily discovered from such grains appearing yellow or ripe, whilst the unaffected grains in the same ears were perfectly green. "On opening those grains that seemed diseased," Mr. Marsham "found in many of them an orange-coloured powder, and in several one or two very minute larvæ, differing in colour from a yellowish white to a deep yellow. They were thick at one end, and gradually diminished to a point at the other, where the head was situate. They extended and contracted themselves at pleasure; to which was added a leaping motion, frequently jumping full half an inch from the paper on which I examined them. The grain where these insects had possession appeared a little shrunk." In the first week of August, Mr. Markwick, of Catsfield, near Battle, found some of the insects in a few ears in his fields; they were lodged between the husks or outward scales of the calyx, which were discoloured, but the grain did not appear to have received any injury. He never met with it in the state of a small white larva, but it was always of a bright yellow colour, and changed into an egg-shaped chrysalis of the same colour. Subsequently he found the larvæ between the corolla and the grain, and even on the grain itself, but he could never discover that they had eaten into any of them. In the October following he was persuaded that his wheat had received no damage from the presence of these minute insects; and he adds, that "since the harvest has been got in I have found the same insect in the husks of the wild bearded oats, *Avena fatua*, but have not yet seen it in its fly or perfect state." In the summer of 1795 Mr. Kirby found citron-coloured larvæ between the corolla and the grain, in the neighbourhood of Ipswich, in Suffolk.

Mr. Markwick again in 1797† first noticed some of the little flies on the 12th of July; they were sitting between the husks of the ears of wheat, the next day they were more abundant, and then he also found a few of the small yellow larvæ of the *Cecidomyia* lying close to the stamina (fig. 10); he observed them in much greater abundance later, but he thought the fly was reduced in numbers at that time. Mr. Markwick bred the *C. tritici* (?) and *Platygaster tipulæ*, from ears inclosed in a flower-pot, but he says the *Cecidomyia*, for such it is by a figure given from one of his specimens,‡ "was as

* *Transactions of the Linnean Society*, vol. iii. p. 242.

† Ibid. vol. iv. p. 225.

‡ Ibid. Plate 19, fig. 2, a, b.

minute, if not less (than the parasite), with a yellow body, spotted and transparent wings, and long-jointed antennæ, beset with small hairs or bristles at each joint." Mr. Marsham terms the spots on the wings "obsolete clouds." I am particular in noticing this, because the wings of Mr. Kirby's *C. tritici* are not spotted, nor are any individuals that I have seen, and excepting the *C. pictipennis*, which is larger, I know of no species of the genus with spotted wings.

In the same volume of the *Linnean Transactions* was published Mr. Kirby's admirable paper illustrative of the history of *Tipula tritici* and its parasite. In 1797 Mr. Kirby says, in a letter to Mr. Marsham, he could scarcely pass through a wheat field in which some florets of every ear he examined were not inhabited by the larvæ of the *Tipula*, but very few pupæ, not one in fifty. About the beginning of September he bred one of the flies, and describes it as well as the parasitic ichneumon. He searched in vain for more flies in the corn fields and barns soon after, but could find none, from which he concluded they did not hatch in general in a natural way until the spring, so as the female might be "in readiness to deposit its eggs in the wheat, when it has made so much progress in growth that the larva may be hatched about the time of its going into blossom; and I am confirmed in this opinion by another circumstance. A few days since (the fourth week in September) with a fine needle I carefully took off the thin membrane from two of the pupæ which I had reserved, that I might see how near they were to a change of state; but instead of discovering the lineaments of the future fly, the insect was still in the form of the larva: so that probably the pupa is not usually complete until the spring, and the insect incloses itself in a thin membrane to protect itself from the cold of the winter." Mr. Kirby adds—"It may be objected that this was probably the larva of the ichneumon, which had devoured that of the *Tipula*. To this I reply that it was, in colour, form, and in every respect so exactly similar to the latter, that it could be no other."

"I have seen," continues the same learned naturalist, "more than once, seven or eight florets in an ear inhabited by the larvæ, and sometimes so many as thirty in a single floret, seldom less than eight or nine, and yet I have scarcely ever found more than one pupa in an ear, and had to examine several to meet with that. What then becomes of the remainder of the larvæ? Are they destroyed by that of the ichneumon? or do they become the prey of some other insect? or do they fall to the ground when they assume the pupa, and remain there until the following spring? To give a positive answer to any one of these queries I shall not pretend; I will only relate circumstances, and point out from them what appears to me to be most probable.

The pupæ that I have observed have generally been somewhat attached to the grain, and, what is worthy of notice, I never found them within those florets where the larvæ had taken up their residence; they seem invariably to choose for their habitation, in their intermediate state, one where the grain is uninjured, to which they may attach themselves (fig. 16). A question here arises, how they contrive to get from one floret to another, having no feet. But as I have never seen them do this, I will not attempt to conjecture how they do it. In the field above-mentioned I took up many roots of stubble, with a large lump of earth round them, to see if I could discover any of the pupæ concealed in it; but if they were there they escaped my eye, from their minuteness: yet it seems not probable, nor analogous to the general proceedings of nature, that it should be indifferent to them whether they go under ground or remain in the ear when they assume the pupa. That they are destroyed by any other insect than the ichneumon I have no reason to believe, having never seen them attacked by any other; therefore it seems to me most probable that this little friend to man is the destroyer of by far the greatest part of them."

These unsettled points a few years since attracted the notice of Professor Henslow, but he failed, as well as myself, in obtaining satisfactory evidence towards settling these obscure traits in the economy of the wheat-midge; we must therefore rely upon the exertions of the intelligent farmer to supply the deficiencies.

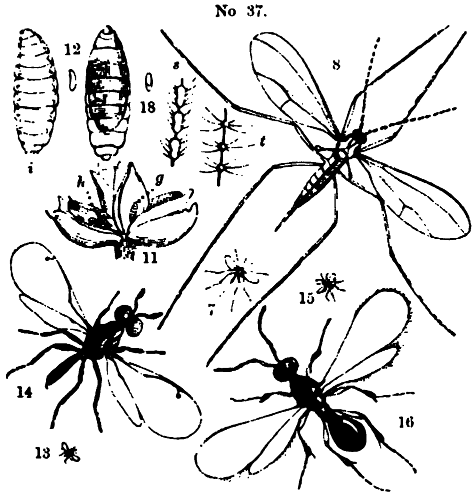
Mr. Kirby is of opinion, as well as Mr. Markwick, that the larvæ "feed upon the pollen or dust of the antheræ, for in those florets in which it resides the germen never swells, and the antheræ are persisting (fig. 10, *d*, *e*); from which it seems evident that the impregnation of the germen is prevented, either by the insects using some means, perhaps a kind of gluten, to prevent the pollen from bursting from the antheræ, or, *vice versâ*, by doing something to the stigma to prevent the fertilization of the germen. The pollen of three antheræ is a store which will maintain sometimes thirty of these creatures from the time that the wheat is in blossom until it is nearly, if not altogether ripe. I could never discover that the grain was injured in any other way by this insect, but it invariably produces the inanition of it in the floret which it inhabits. It may always be detected by the discoloured appearance of the base of the corolla, which is its usual station."

In February, 1799, a letter from Mr. Kirby was read at a meeting of the Linnean Society,* which is so full of interest that I shall be excused for drawing largely upon it in the present instance. "It chanced that, on the 3d

* *Transactions of the Linnean Society*, vol. v. p. 97.

of June last (1798), I had occasion to pass through a field planted with wheat, in the evening, and, to my great surprise and satisfaction, my attention was immediately arrested by an innumerable host of our *Tipulæ* flying about in all directions (Plate I., and No. 37, figs. 7); and from that day to the latter end of the same month these insects were always to be met with in the wheat fields. They were seldom to be seen much before seven o'clock; at eight the field appeared to swarm with them, at which hour they were all busily engaged in laying their eggs, and about nine they generally disappeared. They were indeed so extremely numerous, that if each of them were to lay its eggs in a different floret, and those eggs were permitted to produce larvæ, I think, upon a moderate calculation, more than half of the grain would be destroyed. I have noticed twelve at one time depositing their eggs in the same ear. It is remarkable that, amongst the myriads that I have seen of the female, I should not have observed one which I could take for the male; indeed, towards the latter end of the month, I took two or three specimens, which, except that they had black bodies and were smaller, appeared exactly similar to our *Tipula;* but as neither their antennæ are hairy, nor their wings spotted, as was the case with the specimen you received from Mr. Markwick, they can scarcely be the male. Indeed, the appearance of the male, instead of being later than that of the female, ought to be as early, or earlier, in order that they may be in readiness to perform the work of impregnation previous to the season in which the females lay their eggs, which begins, at least it did this year, with the month of June. Hence I suppose that each sex is disclosed from the pupa in the genial month of May.

No. 37.



"Although these insects are so numerous in the evening, yet in the morning not a single one is to be seen upon the wing: they do not, however, then quit the field which is the scene of their employment; for, upon shaking the stalks of the wheat, or otherwise disturbing them, they will fly about near the ground in great numbers. I found their station of repose to be upon the lower part of the culm, with their heads upwards.

"It is very entertaining to observe the method to which these insects have recourse in order to deposit their eggs in a situation where the larvæ may soon arrive at their food: when engaged in this employment they are not soon disturbed, which circumstance affords the observer an excellent opportunity of examination. As I hinted before, a number may be seen at the same time upon one ear: they place themselves in such a position that their anus stands nearly at right angles with the margin of the glume of that floret which they mean to pierce. But how are they to introduce their eggs within the floret, for they deposit them between the exterior and interior valvules of the corolla? To look at them when they are not engaged in this employment, their anus appears to be furnished with no instrument adapted to so nice an operation; but upon pressure it exerts a long retractile tube or *vagina*, which unsheathes an *aculeus* (if I may so term it) as fine as a hair, and very long (fig. 8, *r*). This aculeus it introduces into the floret, and there deposits its eggs, which it usually places upon the interior valvule of the corolla, just above the stigmata. After she has done laying her eggs, the insect withdraws her aculeus with great caution and deliberation; yet it sometimes happens that she is unable to effect this, in which case she is detained a prisoner until some enemy devour her. In this situation I have found them more than once in my morning walks. I was very desirous of seeing the eggs pass through the vagina, but my first attempts were unsuccessful; at length I was gratified with this pleasing spectacle. I gathered an ear upon which some of the *Tipulæ* were busy, and held it so as to let a sunbeam fall upon one of them, examining its operations under the three glasses of a pocket microscope. I could then very distinctly perceive the eggs passing, one after another, like minute air-bubbles, through the vagina, the aculeus being wholly inserted into the floret. I examined this process for full ten minutes before the patient little animal disengaged itself, and at last it was through my violence that she discontinued her employment, and flew away.

"On the 7th of June, upon opening a floret, I discovered a small patch of eggs; they were oblong, transparent, and of a pale buff colour. I afterwards found several of these little patches, containing from a single egg only to more than twenty. On the 17th I found for the first time a larva newly hatched: it adhered to the lower end of one of the anthers (fig. 14), and was perfectly transparent and colourless; from which circumstance I conjecture that it had taken no food. I afterwards detected two more in a similar situation, one of which had become straw-coloured from the contrary cause. In another floret, upon the same day, I found many with their heads immersed in the woolly summit of the germen; some were in the interior valvule of the corolla, others appeared to be busy upon the plumose stigmata, upon which I did not observe that any pollen had been discharged from the anthers. Upon the 22d I observed that the lárvæ were usually in the situation represented in the accurate drawing engraved in the third volume of the Linnean Society's *Transactions* (fig. 10). All circumstances considered, it seems to me most probable that these animals do not feed upon the pollen before it is discharged from the anthers (except perhaps when they are newly hatched); yet one would think that in this case sufficient must escape them to fertilize the germen. How they prevent this I can but conjecture; as their heads are often immersed in the stigmata and in the down observable upon the top of the germen, it is possible they may occasion an obstruction in those fine ducts through which the fertilizing principle passes down into the grain, or they may consume that spermatic moisture upon the stigma, without the aid of which the pollen cannot perform its office. On the 29th the parent *Tipulæ* had all disappeared, and soon after this period my investigations were stopped by illness; but as I had brought them down so far as to connect them with those made last year, this interruption was of less consequence."

M. Herpin is of opinion that it is an inhabitant of France. He says, "I have also found in ears of corn at the time of flowering many little yellow larvæ, very lively, from 2 to 3 millimètres long, lodged between the chaff of the grain; these larvæ nibble and destroy the generative organs of the plant, and the germen where they are found are sterile. These larvæ appear to me to have a very great analogy with those which have been described in the *Linnean Transactions* under the name of *Tipula tritici;* it is probably a *Cecidomyia*." He also found in the bottles where some diseased ears of barley and wheat were preserved, many *Cecidomydes* in the state of perfect insects.*

The first time I had an opportunity of observing the economy of the wheat-midge was in July and August, 1840. On the 10th of the latter month, Mr. E. Bennet, of Rougham Old Hall, showed me some ears of a red wheat, called "Old Kent," which had a reddish brown appearance, and when the culms were opened a red powder was discoverable (figs. 11, *h*): upon the backs of some of the grains, which were more or less shrivelled, I observed a long, narrow, filmy sac (figs. 11, *g*), on opening which a bright orange granulated maggot came out alive (figs. 12); it was attenuated before, with two minute black dots like eyes, and when shut up in a tin box, many voluntarily left their cases and wandered about; but although I placed them in a pot with sand and earth, I did not succeed in rearing them. The orange dust, which I took for the excrement of the larvæ at first, from constantly finding it with them, was composed of oval granules (fig. 15), and when highly magnified appeared to be dotted (fig. *k*). I suppose it was the red-rust, *Uredo rubigo.*†

* Herpin's *Memoir*, p. 29.

† *Journal of the Royal Agricultural Society*, vol. ii. p. 9.

I have already alluded to Professor Henslow's papers which have been published in the journal referred to,* and it will be only necessary to review his valuable observations as briefly as possible in connection with some materials and notes transmitted to me upon the subject. In January, 1841, he sent me a packet of fine sifted dust from wheat, containing larvæ and pupæ apparently in various stages of growth; the small ones, which were of a very bright red colour, he thought it possible would prove to be another species, and from the quantity of minute seeds mixed with the barn-dust, I think it probable they might be attached to some of the grasses. The larvæ, he observed, were first of a lemon colour, and some became of an orange tint after the wheat was housed in the barn, which might arise from their dying and becoming dried. When perfected they were inclosed in a thin transparent skin, by which they seemed to adhere to sound grains and to the inside of the chaff-scales (figs. 16 and 17). Whilst most of the larvæ remained secreted during the winter amongst the chaff, many of them quitted the ears and fell to the ground, when they buried themselves; these Professor Henslow had good reasons to believe were punctured by the parasitic ichneumons;† but we both failed in proving the fact, as the whole of the larvæ died. Some of them, I believe, were alive in January. I entertain the same opinion as Mr. Kirby, that they lie as larvæ in the transparent cases until the spring, when they become chrysalides, for this power of remaining in a quiescent larva state is common to many orders of insects,‡ and no doubt is a provision to retard their premature appearance, and thus secure species from casualties which might lead to their extinction. This, however, being an important point in their economy, is deserving our attention.§ In a natural state the corn would generally be beaten down in the winter; if not, the grains would fall out, get buried, and vegetate; or they might lie in the calyx or chaff protected. May not the attached larvæ, inclosed in their cases, thus pass the winter, and in the spring change to pupæ in the earth?‖ Of course a vast quantity would be destroyed by birds and vermin feeding on the grain, but the housing and thrashing of the corn being an artificial system, we must look

* *Journal of the Royal Agricultural Society*, vol. ii. p. 24. † Ibid. p. 26.

‡ As the saw-flies or Tenthredinidæ amongst the Hymenoptera, and the Sphingidæ and Bombycidæ amongst the Lepidoptera, some of which remain two years or more in their cocoons. See Curtis's *British Entomology*, second edition, folio 3, p. 4.

§ This part of their economy has since been confirmed by Dr. Asa Fitch. In a letter to me he says, "I have found these larvæ common, slightly under the surface, in the spring, in fields where wheat grew the summer before; and have bred the midge, but not any parasites from them; so the idea that those which leave the wheat are punctured by ichneumons is erroneous."

‖ It is true that Mr. Kirby bred a wheat-midge from the *ears* of wheat, but that was late in the summer, and I am not aware that any one has bred the spring broods, which must first deposit their eggs in the growing corn.

to the process the insects would be liable to in a state of nature. If some infested corn were left to stand at harvest, and examined weekly, it would in all probability throw considerable light upon this puzzling but important stage of their economy. The wheat might be transplanted, and protected from birds by netting, for the object would be to have the ears exposed to the variations of the atmosphere, and the earth naturally moist to receive the larvæ, if they were disposed to leave their filmy cells. It may also be asked, If the mass of the larvæ are transformed to flies during or soon after harvest, where do the parent midges come from that deposit their eggs in the growing corn whilst in flower the following summer? If, indeed, this insect will live also in the glumes of *early* grasses, which is quite possible, that would solve the difficulty; but I am of opinion that the specimens bred by Mr. Markwick and Mr. Kirby late in the summer, may be considered as exceptions to the usual economy of the insect, for at that period of the year there is no corn in a fit state to receive the eggs of the females.

We may here introduce with advantage some valuable observations regarding the economy of the wheat-midges of North America,* as recently reported by H. Y. Hind, Esq., M.A., professor of chemistry at Trinity College, Toronto:†—

It now appears that "in damp weather the larvæ wriggle down to the ground, and penetrate about half an inch or an inch below the surface. Here they remain until the following spring, still retaining their maggot state. In the month of May they assume the pupa condition, and preserve it for two or three weeks, when they wriggle themselves to the surface of the ground, break their pupa skin, and assume the form of the midge."

"The dried larvæ which are thrashed out of the corn, and are thought by many to be dead, when exposed to moisture swell until they fill the case or skins in which they are inclosed, and the worms crawl or wriggle away to a place of security. The vitality of these larvæ is so great," says Dr. A. Fitch, "that after being kept for months in a dry, stove-warmed office, on being placed between the folds of a wet cloth, they will next day be found actively crawling about within the cloth, till, reaching its outside, they, with a skip, throw themselves away from it, not one of them leaving a carse or empty skin behind in the cloth."

Of all the remedies recommended in America, deep ploughing appears to be attended with the best success.

The wheat-midge is not confined to any particular districts that I am

* One called by Dr. Asa Fitch *C. tritici*, the clear-winged wheat-midge; the other *C. cerealis*, the spotted-winged wheat-midge.

† See the *Rural New Yorker*, for 1856, and the *Farmer's Herald*, for March and April, 1858.

aware of; it has certainly been observed in Norfolk, Suffolk, Hertfordshire, Sussex, Dorsetshire, Devonshire, Cornwall, Shropshire, the north of Ireland, and Scotland. On the 17th of June, 1842, I found the flies abundant near Glanville's-Wootton, Dorset: in walking through a wheat field, which was just coming into ear, with here and there a spike in flower, I saw the little ochreous *Cecidomyiæ* flying about, alighting on the ears, and getting a little between the chaff. They were all females, as far as I could observe; with them I also detected a few of the parasitic *Platygasters*. Having now detailed all that is known relative to the economy of the British wheat-midge, I will describe the fly. It belongs to the order DIPTERA, the family TIPULIDÆ, and was formerly included by Linnæus, Kirby, &c., in the genus TIPULA, but owing to its structure, and the neuration of the wings* departing considerably from the typical species, it has very properly been separated from that immense group, and is now designated by Meigen and others—

3. *Cecidomyia tritici;* the *female* (figs. 7; and 8, the same magnified) is pale ochreous, pubescent; eyes intensely black, and coarsely granulated, meeting on the crown and covering nearly the whole head; ocelli none; no part of the mouth is visible, except a short bilobed pilose lip, and two incurved palpi or feelers, they are four-jointed and slightly pilose; the antennæ are stretched forward or curved upward, and inserted close together in front of the face; they are as long as the body, pale brown, and clothed with longish hairs; they are composed of thirteen sub-elliptical joints, contracted round the middle, and connected at the ends by a single thread, like a string of beads (figs. *s*): thorax ovate, and deep reddish ochre; scutellum transverse oval: abdomen rather short and tapering to the apex, which is furnished with an ovipositor nearly thrice as long as the body, the sheaths at the base stout, the oviduct exceedingly slender (fig. 8, *r*): wings incumbent in repose, longer than the body, yellowish white, and beautifully iridescent, pubescent, and ciliated, costal nervure surrounding the wing, subcostal short, second extending to the margin, third shorter, the apex forked: two halteres or poisers large and capitate: six legs, long, slender, and nearly of equal length; thighs and shanks equally long; tarsi or feet five-jointed, basal joint minute in all, second as long as the tibiæ, the remainder decreasing in length; claws very minute (fig. *u*, the articulated foot). The *male* I have never seen, but no doubt the antennæ are different, being usually composed of twenty-five globose joints, which are more remotely strung than in the female,† as exhibited in figs. *t*.

Mr. Kirby describes the pupa or chrysalis as slender, acute at both ends, and of a reddish colour.

* See Curtis's *British Entomology*, Plate and fol. 178, for dissections.

† Ibid. Plate 178, fig. 3.

In addition to what has been already said of the larvæ, it may be added, that the greater number I have seen were of a lemon or pale orange colour; they tapered to the head, which was pointed when they were in motion, and the tail was rounded, the sides being plaited or wrinkled, and forming little tubercles which assist it in locomotion (figs. 12; *i*, the same magnified): the skin or membrane in which they were so often inclosed, although white and perfectly transparent, was of so close a texture that it was like a bubble of gum, and all that I examined were impressed with the transverse sutures corresponding exactly with the abdominal segments of the larvæ (fig. 18, *p*), and it is worthy of remark that all these cases were fractured at the head, as if an attempt had been made to escape, which was supported by the fact that their tails did not reach the apex of the case (figs. 18).* On taking out these larvæ in January I found them dead, depressed, hardened, and granulated (fig. 19); they were composed of ten distinct and two less defined annulations, the penultimate one was notched beneath (fig. *q*), and the intestinal canal shone through on the under side. I have added a magnified figure, from a drawing made for Sir Joseph Banks, and published in the *Linnean Transactions* (fig. 13),† as it shows the papillæ or nipples which assist the larva in walking, but it does not give the character of those which I have seen.‡

The genus *Cecidomyia* is an extensive group, containing nearly thirty British species,§ and one of the most remarkable features in their history is the great differences which exist in their economy: a large portion of them form downy excrescences, like galls, upon various plants, as the field wormwood, ground-ivy, a species of speedwell, and the common campion; others inhabit the leaves of the Scotch fir, the buds of a sallow, and the flower-buds of the common hedge-mustard,|| and there are a few which Bouché says infest decayed tulip and hyacinth roots and half-decayed cow-dung.

Mr. Kirby describes three minute parasitic insects which seem to have been ordained by the Author of the universe to limit the depredations of the wheat-midge, and they so effectually execute their mission, that it has often happened, a year or two after the midges were in excess, not a specimen could be found. As these insects are most interesting objects, as well for their valuable services as for their curious habits of life, I shall enter with pleasure upon their histories in the succeeding chapter.¶

* I find that Mr. Gorrie has stated, in the *Magazine of Natural History* for 1829, that all the larvæ had deserted the wheat-ears and descended into the earth by the 1st of August, about ½ inch only below the surface.

† Vol. iii. Plate 22, fig. 12.

‡ Professor Henslow is inclined to think, from differences in the larvæ he has examined from various localities, that there is more than one species of wheat-midge. See his *Report*, vol. iii. p. 39.

§ Curtis's *Guide*, Gen. 1149.

|| See *Gardeners' Chronicle*, vol. v. p. 400, *Cecidomyia barbareæ*.

¶ The parasites represented in the woodcut, No. 37, figs. 13–16, are *Macroglenes penetrans* and *Platygaster tipulæ*.

Notwithstanding these valuable agents, we find the amount of damage very considerable, as will be shown by the result of Mr. Kirby's examination in the neighbourhood of Barham, in Suffolk. "To ascertain the quantity of mischief produced by one *Tipula* within particular limits, I went to a field of fifteen acres, which was planted partly with white and partly with red wheat. In this field I took five stations, one on each side and one in the centre. In each station I examined a certain number of ears, grain by grain, without selection. The result was that in thirty ears of white wheat, seventy-three grains were destroyed by the larva, which is at the rate of not quite two and a half grains to an ear; and in twenty ears of red wheat twenty-nine grains were destroyed, which is nearly at the rate of one and a half grain to an ear. Take the whole together, and the proportion will be about two grains in an ear, which I suppose may be about a twentieth part of the produce, and would make a difference of at least five coombs in the crop in this field.* The white wheat in this instance was most exposed to the attack of the insect; whether this be generally the case, must be determined by future experiments upon a more extensive scale. Least mischief seemed to be done on the south side of the north hedge; but no part escaped wholly—not an ear I examined but what had sustained some injury. From this field that I have been speaking of I went to another, which was sown later in the autumn; in this I found scarcely any of the larvæ." †

Mr. Markwick, who in the first instance did not consider the wheat-midge did any serious mischief, subsequently became satisfied that Mr. Kirby's average of two grains in each ear was not too much to attribute to the operations of the larvæ, for "he scarcely examined any ears in which there were not more than that injured." In the ears transmitted to Mr. Marsham, from two to six grains were inhabited by them, and their numbers exceeded those represented in the plate (fig. 10), and in one or two he found what appeared to be a pupa. Mr. Gorrie estimated the loss in the late-sown wheats in Perthshire, in 1828, at one-third of the crop; ‡ and the following statement, communicated by Mr. P. Bell, of Mid Lioch, and dated June 24, 1830, clearly

* Monsieur Bazin, in his valuable *Memoir*, has since alluded to the deficient harvests during the years 1853–55, in the arrondissement of Joigny, and the departments of the Yonne and Picardy, and his brother observed the same malady in the department of the Oise. Since 1852 it is affirmed that an eighth and even a seventh of the crop has been destroyed. M. Bazin found the wheat-midge from the middle of June to the middle of July; the eggs hatched in eight or nine days; some of the larvæ leap out of the glumes to bury themselves and become pupæ in the earth, others are carried into the granary with the corn. See *Notice sur le Cecidomyie du Froment*, par M. C. Bazin. Paris, 1856.

It may be added that the ravages of this insect have extended to Nova Scotia, as detailed by Mr. J. W. Dawson, and published in the *Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. iv. p. 210.

† *Transactions of the Linnean Society*, vol. iv. p. 237.

‡ *Magazine of Natural History*, vol. ii. p. 292 and 324.

shows the apprehensions occasioned in Scotland by its successive appearance. In alluding to the wheat crop he says, "I found dozens of the insects busily at work depositing their eggs among the soft chaff of the young ear. We are anxious that the present cold weather should continue for another ten days, to prevent the eggs from hatching until the wheat be sufficiently hardened, and beyond the state which affords nourishment to the maggot. Another year or two of the wheat-fly will make two-thirds of the farmers here bankrupts."*

In 1841 Professor Henslow found that every field from which he had obtained specimens had been attacked by the midge, and there were larvæ present in almost every ear. A tall description of Revet wheat had particularly suffered; in one well-grown ear only nine sound grains remained, the rest had been rendered abortive by this insect, and the yield was calculated at one-third less than was expected. This is not surprising when we learn that, from the chaff and dross collected upon barn floors in three different localities, where the wheat was thrashed and dressed, Professor Henslow made a calculation, by which it appears that seven bushels of the dust contained 834,952 larvæ and pupæ of the wheat-midge.†

Before entering upon the remedies suggested, it will be desirable to review the economy of the wheat-midge; but I fear that the ingenuity of man will never devise any method for the destruction of this little rogue in grain, when it has once taken possession of a standing crop. In June the eggs are laid in the ear whilst it is in flower and the incipient corn is tender; the larvæ live amongst the parts of fructification until they are full grown, after which they change to pupæ upon the sound grains and inner valves, or enter the earth to undergo their transformations, some of the flies hatching in the summer, and the majority in the following June, it is believed.

I should expect that the early wheats would generally suffer the most, but as the attacks of the wheat-midge are irregular and uncertain, even if the fact were established, any attempt of the farmer to avail himself of such knowledge could not be relied upon. To apply any remedy when the ears are once inoculated, I think impossible; it seems to be only in the pupa state that they can be assailed. Professor Henslow's suggestion, therefore, appears to be the most feasible, and best calculated to check their increase, provided the larvæ and pupæ carried into the barn do not die from the artificial state in which they are placed. He recommends the use of a sieve, sufficiently open to let the pupæ and larvæ pass through with the dust, which must be removed and burned. He says, "It occurred to me that if a wire-gauze sieve were placed before the winnowing machine in a sloping position,

* *Gardener's Magazine*, vol. vi. p. 495.

† See the tables, &c., in *Royal Agricultural Journal*, vol. iii. p. 38.

so as to allow the chaff to fall upon it and then roll from it, the pupæ would pass through, and might be caught with the dust in a tray placed below the sieve. I have put this to the test of experiment, and find it answer perfectly. Two pieces of wire-gauze were placed together at an angle, sloping like the roof of a house, and the chaff readily fell off on each side to the floor, whilst dust and pupæ passed through. If a simple contrivance of this kind formed an appendage to every winnowing machine in the country, what myriads on myriads of the pupæ might be collected and destroyed! The researches which I have made on the subject since my report was written, have satisfied me that the damage done by this minute insect is much greater than agriculturists are at all aware of." *

Sauter † gives the history of another little gnat or midge, exceedingly injurious to barley and a variety of dwarf wheat called spelt; there is every reason to believe it is a *Cecidomyia*, and he has named it—

TIPULA CEREALIS—*the Barley-Midge.*

In the grand duchy of Baden, during the years 1813 and 1816, the destruction occasioned to those crops by the larvæ of this little midge was very alarming. They are of a vermilion colour, and from 1 line to 1½ line long: they make their appearance in May and June, living in families between the leaf-sheath and the stalk, eating the straw, which thereby becomes warty, notched, and crooked, and eventually dies.

The larva, like its allies, has no feet, and is stated to be composed of nine segments, including the head and tail, both of which it is able to retract and extend, but between each abdominal ring on either side there are small hooks bent forward. The larvæ enter the earth to undergo their transformations when they are full grown.

The perfect insect, like most of its congeners, is very ephemeral, having only a few hours to accomplish its destiny, whilst the time it is passing through its transformations occupies, it appears, from two to three years The perfect insect is brownish red, and the two wings of a silvery colour; the horns are bristle-shaped, longer than the body, and composed of thirteen joints.

Dr. Sauter, in order to destroy this pest, proposes to mow all the fields at the period when the development of the perfect insects is completed, so that the eggs which are laid and the larvæ that are hatched may both be destroyed. This remedy may be thought as bad as the disease; yet the loss might not be

* *Gardeners' Chronicle*, vol. i. p. 52.

† Germar's *Mag. der Entom.*, vol. iii. p. 366. The *C. cerealis* of Dr. Asa Fitch is a different species.

so great as it would at first appear, and it must effectually prevent the reappearance of the barley-midges.

The oats of Styria and Carinthia received great damage several years since, probably from the same, or a nearly allied insect. In this instance the devastation of the oat fields was repeated for several successive years, when they disappeared, which is attributed, by Köllar,* to the mowing down the infested oats whilst the insects were in the larva state.

The economy of this species bears a great resemblance to the Hessian fly, which, however, does not enter the earth to undergo its metamorphoses; and it is very remarkable that three species, so closely allied to each other, should vary so considerably in their habits. With regard to the Hessian fly, even if its presence could be ascertained in the early stages, it does not seem possible to devise any means of destroying the eggs or young larvæ, unless feeding off the blade with sheep would effect the object; and when their progress is detected by their mischievous works, at a more advanced period, nothing, I apprehend, but sacrificing the crop would arrest them. It appears, therefore, to be an evil to which we must occasionally submit; but to guard against its immediate recurrence, it will only be necessary to collect and burn the stubble after the corn is reaped, by which means the larvæ and pupæ that are concealed at the base of the stalk will, of course, be destroyed. Köllar recommends agriculturists, as a means of prevention, to refrain from sowing wheat the following year; but whether such a system could be adopted in North America, I am not prepared to say.

SUMMARY OF THE FOREGOING CHAPTER.

Larvæ of a saw-fly called *Cephus pygmæus* destroy the rye by injuring the straw; they live through the winter, change to pupæ in March, and the flies hatch in April.

The female fly pierces and deposits her *eggs* in the *rye-straw*, or immediately below the *ear:* the *larvæ* live in the interior, piercing the knots, and about harvest time cut through the stem close to the ground, descend into the remaining stubble, and change to *pupæ.*

This *insect* is *detected* by the *ears* becoming upright and *apparently ripe* in the infested plants, whilst the remainder of the crop is green.

A *field* thus affected sometimes looks as if it had been *traversed by sportsmen* and animals.

This *saw-fly* is very abundant in *corn-fields*, particularly amongst barley, in June and July, in many parts of England.

* *Naturgeschichte der schädlichen Insecten*, p. 136.

It also infests the wheat crops.

On the western coast of *France* this insect has caused great ravages, and similar losses have been sustained in *Africa*.

The *ears* both of wheat and rye become *sterile* from the attacks of the *Cephus*.

To *plough in March*, or the beginning of April, would *destroy the larvæ* and prevent the escape of the flies; but *burning* the *stubble* is strongly recommended.

An *Ichneumon*, named *Pachymerus calcitrator*, punctures the larvæ, which become the prey of the young parasitic maggots.

This *fly* is abundant, in *June* and *July*, in various parts of England.

It is *doubtful* if the *Hessian fly* has ever been detected in *Europe*.

In *North America* it has occasioned *famine* by its ravages amongst the wheat.

This *fly*, or an allied species, attacked the wheat crops in *Hungary* in 1833.

Two-thirds of the straw was laid, and produced only *abortive ears*.

These *larvæ* lived in families between the *sheath-leaf* and the straw, near to the crown of the root.

The *larvæ* of the *Hessian fly* also live between the *sheath and the stem*, close to the base.

A parasitic fly, called *Ceraphron destructor*, keeps the Hessian fly in check.

Larvæ of the *British wheat-midge* detected in July, 1795, attacking from one to several grains in an ear.

The infested *grains* appeared yellow, or *prematurely ripe*.

They contained an *orange-coloured powder*, and minute yellowish white or deep yellow *larvæ*.

The same *larvæ*, Mr. Markwick says, inhabit the husks of the "wild bearded oat," *Avena fatua*.

Some agriculturists in Sussex formed an idea at first that the *larvæ* did *no mischief* to the corn.

The *Wheat-midge* was very abundant in the middle of July, 1797.

These *flies* had *spotted wings*, or rather obscurely clouded.

The *larvæ* were exceedingly *abundant* later in the season, but very *few pupæ* were found.

One of the *flies* was bred in *September*, but they probably do not generally *hatch* till the *spring*.

As many as *seven or eight florets* in an ear inhabited by the *larvæ*, and as many as *thirty* in a single floret.

The *pupæ* never found within the *florets* where the *larvæ* resided.

Parasitic *Ichneumons* destroy the greater part of the larvæ.

The *larvæ* feed upon the *pollen*, and the germen never swells.

In *June*, 1798, there were *innumerable hosts* of the female Wheat-midge, but not any males; twelve at one time were laying eggs in a single ear.

They begin to *fly* about *seven* in the evening, and *disappear* about *nine* o'clock.

They may be found in the *morning* by shaking the corn, and will then fly about the ground.

The female deposits her *eggs* between the *valvules* of the *corolla*, by means of her long *ovipositor*.

Patches of the *eggs* found on the 7th of June; on the 17th the *larva* was newly hatched.

This or a similar species has been *detected in France*.

In August, 1840, I found the *larvæ* inclosed in their *cases* upon the grain in Suffolk; which was also affected by red-rust.

All the *cases* were *fractured* at the head, as if the larvæ had attempted, but failed to make their escape.

They *voluntarily left* their *cases* and died.

In January, 1841, they were *abundant* in the *dust* after winnowing the wheat.

The skins, or *cases* inclosing the larvæ, adhered to *sound grains* and the *chaff-scales*.

Some *quitted the ears* and buried themselves: had these been punctured by a parasitic *Ichneumon?*

It seems evident that they *lie* in an *inactive* state during the *winter*.

Very desirable to ascertain if the *larvæ* enter the *earth* to become *pupæ*, and under what conditions.

Where do the *parent midges* come from which deposit the *eggs* in the *standing corn?*

It is possible the same *species* may inhabit both *corn* and *grasses*.

The *wheat-midge* has been observed in *Scotland* and *Ireland*, as well as in a great many counties of *England*.

In *June*, 1842, I found both the *Wheat-midge* and its *parasite* in Dorsetshire.

Nearly *thirty species of Cecidomyia* have been found in this country, and they vary greatly in their economy.

Three different *parasites* check the multiplication of the *British wheat-midge*.

Five coombs calculated as the loss in a field of *fifteen acres*.

At least *two grains* in each *ear* injured by the larvæ.

In Scotland *one-third* of the *crop* was lost, and the farmers suffered severely in 1828 and three following years.

In Suffolk the *yield* of wheat was *one-third less* in some districts, in 1841, than was expected.

The *larvæ* were found in *myriads* in the *dust* from the chaff and dross of the wheat.

Probably most readily *extirpated* by means of a *sieve*, to be used in winnowing, to separate the chaff from the pupæ and dust.

Tipula cerealis injurious to *barley* and *spelt*.

The *larvæ* live in families between the *leaf-sheath* and the *stalk*.

To *destroy* this species, *mow the fields* when the perfect insects hatch.

The *oat crops* in *Styria* and *Carinthia* were similarly attacked for several successive years.

The *mischief* was at last *arrested by mowing* the infested oats whilst the larvæ were in them.

Possibly *feeding* off the wheat with sheep might save the crops from the *Hessian fly*.

Collecting and *burning* the stubble would destroy the larvæ and pupæ of this insect.

Köllar recommends the German farmers to *abstain* from *wheat-sowing* for a year after the midges have been abundant.

EXPLANATION OF PLATE I.

Fig. 1. *Larva* or maggot of *Cephus pygmæus*.
Fig. 2.* The same magnified, in a different position.
Fig. 3. *Pupa* or *chrysalis* (?) of *Cephus pygmæus*.
Fig. 4.* The same magnified.
a, The operculum formed of excrement, &c.
Fig. 5.* *Cephus pygmæus*, the female.
b, The natural size.
Fig. 6.* *Pachymerus calcitrator*, the female.
c, The natural size.
Fig. 7. *Cecidomyia tritici*, the female British wheat-midge.
Fig. 8.* The same magnified.
r, The ovipositor.
*s**, Three joints of the *female* antenna.
*t**, Six of the basal joints of a *male C. tritici*.(?)
*u**, Hinder *tarsus* or foot of the Wheat-midge.
Fig. 9.* Represents the germen, or young grain of wheat, nearly complete, with two of the valvules which inclose it.
Fig. 10.* Is a flower expanded from the same ear, showing the effects of the little *larvæ* which had taken up their residence in the corolla.
*d**, The germen scarcely at all swelled.
*e**, The stamina of their usual size.
*f**, The styles of their usual size.

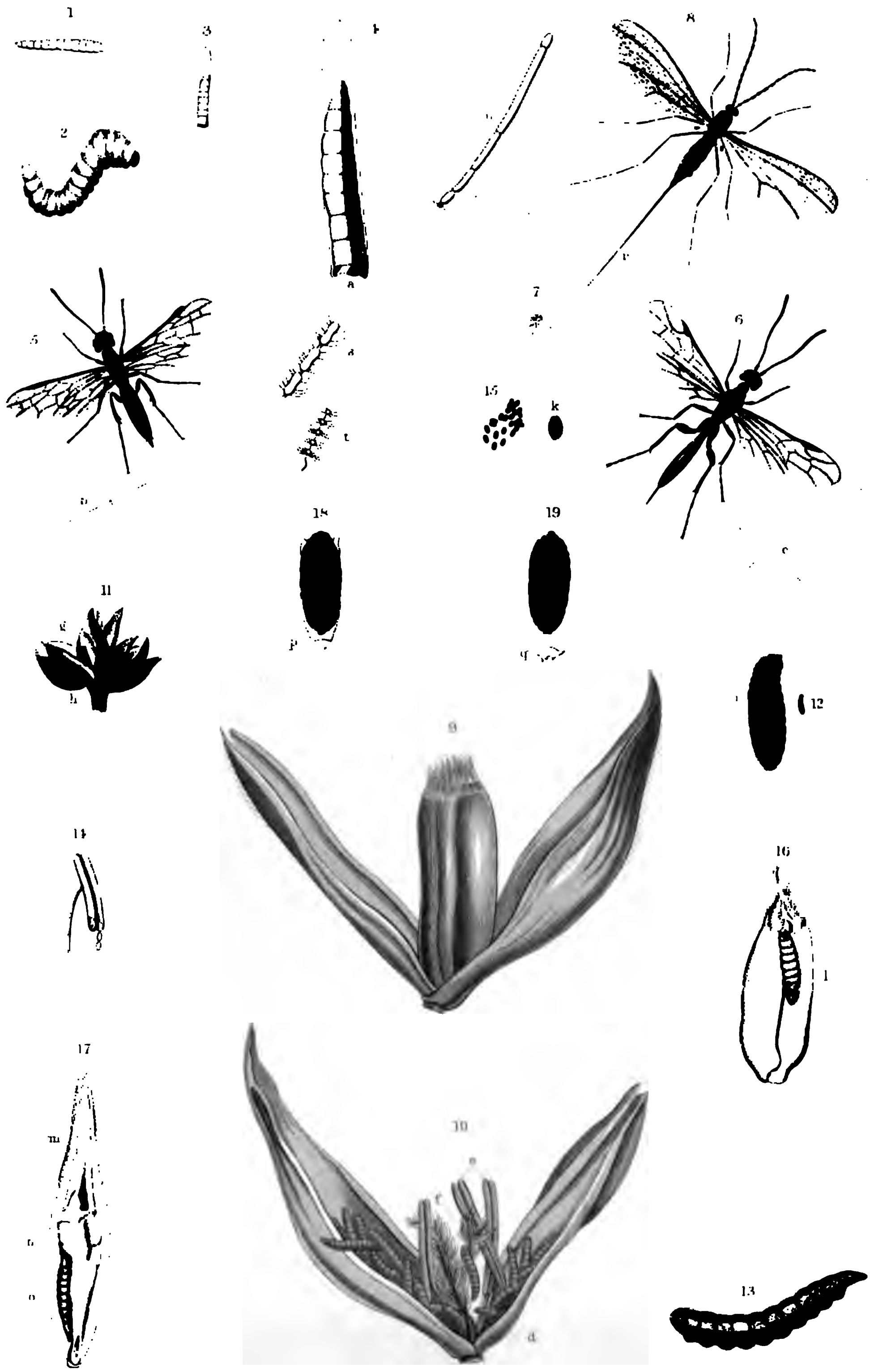
Fig. 11. Represents a grain of wheat with the chaff and valvules opened.
  g, The larva of *Cecidomyia tritici.*
  h, The red-rust, at first taken for excrement.
Fig. 12. The *larva* removed.
  *i**, The same magnified.
Fig. 13.* One of the *larvæ* from the group in fig. 10 greatly magnified.
Fig. 14.* A newly-hatched *larva* adhering to the lower end of one of the anthers; see fig. 10, *e*.
Fig. 15.* A group of the granules magnified.
  *k**, One of them highly magnified.
Fig. 16.* A sound grain of wheat with the larva attached.
  *l**, The *larva* in its transparent case.
Fig. 17.* A shrivelled grain of wheat with the larva attached.
  *m**, The valvule.
  *n**, The shrivelled grain.
  *o**, The *larva* attached in its transparent case.
Fig. 18.* One of these *larvæ* detached.
  *p**, The apex of the transparent skin or case.
Fig. 19.* The dead *larva* removed from its case.
  *q**, The toothed tail.

Those numbers and letters with a * attached refer to the objects which are represented larger than life. All the figures are drawn from nature, excepting Nos. 1, 2, 3, and 4, which are copied from Guérin's *Memoirs;* 9, 10, 13, and 14, from the *Linnean Transactions;* and fig. *t* from Meigen's *Diptera*.

GRAIN CROPS.

PLATE I

Corn Saw-fly with its Parasite, and Wheat Midge with its larvae &c.



CHAPTER X.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS, ETC., AFFECTING THE CORN CROPS; INCLUDING THE PARASITIC ENEMIES OF THE WHEAT-MIDGE, THE THRIPS, WHEAT-LOUSE, WHEAT-BUG, AND ALSO OF THE LITTLE WORM CALLED VIBRIO.

CECIDOMYIA TRITICI—*The British Wheat-midge.*

WHEN the history of the wheat-midge was discussed in the spring of 1845, I had hoped, during the following summer, to make some progress in the further development of its economy; but although the little orange larvæ were abundant in some wheat fields in August in the neighbourhood of Hayes, owing to the wet and cold season I presume, I did not discover a single midge on the wing, and the larvæ appeared to have all died as usual. I have, however, collected materials for detailing the histories of several minute *Ichneumonidæ* that attack the wheat-midge, which are too interesting and important to be passed by without comment. The most abundant, and consequently the most useful of them, is one named *Ichneumon tipulæ* by Mr. Kirby, who remarks, "It is singular, but most people who are acquainted with the larva of the *Tipula tritici* mistake this friendly ichneumon for its parent, and thus impute all the mischief to the very creature which is appointed to prevent it." *

This insect is found upon grasses as early as June, and on the glumes of the wheat in July and August, when it runs over the ears and searches out the infected ones, depositing a single egg in each of the larvæ by means of its sharp tail. The late Mr. A. Mathews, before he left England, sent me specimens, informing me that he had found them in the greatest abundance in the glumes of the wheat in a field near Sittingbourne, Kent, in the beginning of July. Never having seen this ichneumon depositing its eggs, I cannot satisfy the curiosity of the reader better than by transcribing Mr. Kirby's graphic account of its operations. "To see our little ichneumon," says Mr. Kirby, "deposit its egg in the caterpillar of the wheat-fly is a very entertaining sight. In order to enjoy this pleasure, I placed a number of the latter

* *Transactions of the Linnean Society*, vol. iv. p. 236.

upon a sheet of white paper at no great distance from each other, and then set an ichneumon down in the midst of them. She began immediately to march about, vibrating her antennæ very briskly. A larva was soon discovered, upon which she fixed herself, the vibratory motion of her antennæ increasing to an intense degree; then, bending her body obliquely under her breast, she applied her anus to the larva, and during the insertion of her *aculeus* and the depositing of the egg, her antennæ became perfectly still and motionless. Whilst this operation was performing, the larva appeared to feel a momentary sensation of pain, for it gave a violent wriggle. When all was finished, the little ichneumon marched off to seek for a second, which was obliged to undergo the same operation; and so on to as many as it could find in which no egg had been before deposited, for it commits only a single egg to each larva. I have seen it frequently mount one which had been pricked before, but it soon discovered its mistake and left it. The size of it is so near that of the *Tipula* that I imagine the larva of the latter could not support more than one of the former, and therefore instinct directs it to deposit only a single egg in each; besides, by this means one ichneumon will destroy an infinite number of larvæ."

These parasites are all included in the order HYMENOPTERA, and the family ICHNEUMONIDES ADSCITI. The species I am about to notice is comprised in the genus PLATYGASTER.* It has been named by Mr. Kirby *Ichneumon tipulæ*, and is now described as the—

1. *P. tipulæ* (Plate J, fig. 1; *a*, the natural size).—*Female* pitch-coloured, shining: antennæ nearly as long as the body, inserted at the lower part of the face, slender, clavate, geniculated or angulated, as if broken, slightly pubescent, ochreous, and ten-jointed, the four terminal joints brown and obovate, the apical one conical; basal joint long, curved, and clavate; second and third subovate, the latter very slender; fourth a little longer; fifth and sixth minute (fig. *b*): head black, subglobose, thickly and finely punctured, with a minute tooth between the base of the antennæ; eyes oval and lateral, ocelli large, and placed nearly in a straight line across the crown: thorax somewhat globose, with minute pale pubescence; scutellum horizontal, long, conical, and mucronated: the spine ferruginous: abdomen small, scarcely larger than the thorax, slightly depressed, obovate, black and very shining, attached by a short stout pedicel, which is ferruginous at the base; the second segment forms a convex shield, which nearly covers the back, with three or four rings towards the apex; the flexible tip is armed with a very long curved ovipositor, like a hair, which is concealed in the abdomen when at rest: the four

* So named from some of the larger ones having broad bodies.

wings transparent, iridescent, pubescent, and ciliated, destitute of nervures, the superior much the largest, the apex quite round: legs strong, bright ochreous; thighs thickened at their extremities; tibiæ spurred at the apex, very clavate; hinder with the knob sometimes fuscous; tarsi slender and five-jointed. "*Male* black, shining, very smooth, sparingly clothed with short pubescence: head excessively finely punctured, slightly shining: eyes and ocelli pitchy black: antennæ pitchy, first to fifth joints reddish: apex of scutellum fuscous; metathorax and first abdominal segment rough, obscure, pilose: abdomen smooth, shining; second segment with two little pits at the base: legs pale reddish; hinder tibiæ and apex of tarsi pitchy: wings somewhat transparent: scales pitchy."

It seems that the males do not differ, except in a trifling degree, in the structure of the horns, in which, I believe, the fourth joint is larger, and the tenth longer and more pointed; but it is very remarkable, that whilst the females occasionally swarm, so little is known of the habits of the opposite sex that I have not yet been able to meet with a specimen. The only one I ever saw was captured by Mr. Haliday on a rose tree; and the above characters are translated from Mr. F. Walker's paper upon the genus *Platygaster.** This is such an extensive group that he has described ninety-nine species which inhabit this country; and amongst them is one named *P. tritici* by Mr. Haliday, who found it on corn and willows in England and Ireland, and from its specific name it is evident that talented naturalist considered it to be connected with our wheat fields.†

The second species described by Mr. Kirby he has named *Ichneumon inserens:* it is apparently a *Platygaster;*‡ but as I have not been able to find the specimen in his collection, I must be satisfied in transcribing his account, and copying his figures. He says, "Upon the 7th of June, I observed a very minute ichneumon exceedingly busy upon the ears of wheat, which, at first, I took for *Ichneumon tipulæ;* but upon a closer examination, I found it to be a species entirely distinct, as will appear when I come to describe it. As soon as I was convinced of this, and observed that it pierced the florets at a time when no larvæ had made their appearance, I conjectured that it must lay its eggs in the eggs of the *Tipula.*" "This insect is furnished with an aculeus three or four times its own length (fig. *c*), which is finer than a hair, and nearly as flexile. This is commonly concealed within the abdomen; but when the animal is engaged in laying its eggs it is exserted. One day it

* *Entomological Magazine,* vol. iii. p. 220.

† Curtis's *British Entomology,* fol. 309; and *Guide,* Genus 585, where 108 species are recorded.

‡ I have included it in the genus *Inostemma* in the *Guide,* a genus which has been formed out of *Platygaster.* It is the *I. scrutator* of Walker.

named THYSANOPTERA, from the plume-like fringes of the wings, but they were at first included in the *Hemiptera*, and subsequently formed a section of the *Homoptera:* our insect is comprised in the genus *Thrips*, and forms a sub-genus called LIMOTHRIPS, and the specific name is—

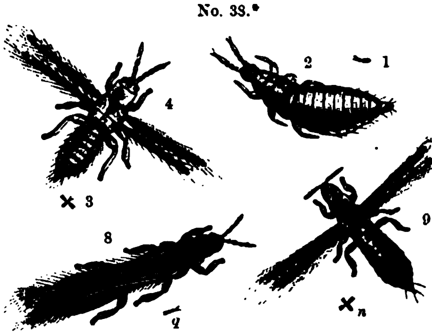
5. *T. cerealium* of Haliday, and *T. physapus* of Kirby.—The larva and pupa are similar in form to the imago, but smaller; "the larva is deep yellow, with the greater part of the head and two spots on the prothorax dusky. The antennæ and legs have alternate rings of pale and dusky: the pupa paler yellow, with the antennæ, legs, and wing-cases whitish, the latter reaching to the middle of the abdomen. The eyes are dusky red, and the simple eyes sometimes indicated by red dots."* The perfect insect is smooth, shining, piceous, often black, depressed, and about three-fourths of a line long. The male is apterous, the female winged: the head is ovate truncate, concave on the crown, with a channel down the centre: ocelli three, distinct, forming a large triangle on the crown; eyes remote from the base, lateral and oval, coarsely granulated; the collar not contracted: antennæ inserted before the eyes, approximating, a little longer than the head, slightly bristly, nine-jointed, two basal joints the stoutest, oblong; the third and fourth rather longer, obovate, with a gland at the apex appearing like a small joint; fifth obovate; sixth elongate ovate, truncated, the remainder tapering; seventh oblong; eighth minute; ninth twice as long, very slender, the apex pilose: face inclining obliquely beneath, terminated by the trophi, which unite and form a short beak close to the anterior coxæ:† thorax somewhat quadrate, sometimes a little narrowed before with four impressed dots, two on each side; scutellum short, somewhat lunate: abdomen long, narrow, and smooth, composed of nine segments; apex ovate or conical and bristly, the last segment armed with two lateral spines in the male; acuminated in the female: ovipositor or borer four-valved, incurved, compressed, concealed in the under side of the eighth and ninth segments: wings four, as long as the body, narrow, horizontal, incumbent, and parallel in repose, but curving outward and not meeting; superior rather coriaceous, fuscous, but pale at the base, ciliated with long hairs, and having three longitudinal nervures; inferior a little shorter, membraneous, transparent, and iridescent, likewise ciliated: legs remote, anterior very short and stout in the female, hinder the longest; first pair of thighs thickened, but compressed in the female; anterior tibiæ straw-coloured in the same sex, with a protuberance on the inside and a curved claw at the apex; the others simple; tarsi very short, straw-coloured, bi-arti-

* *Entomological Magazine*, vol. iv. p. 146.

† For descriptions and figures of the mouth, antennæ, &c., consult Curtis's *British Entomology*, fol. and Plate 748.

culate, basal joint oblong; second short, terminated by a little gland; claws none. Plate J, and No. 38, figs. 8, exhibit the female walking; figs. 9, the same sex flying, both greatly magnified, as is shown by their natural dimensions at figs. *q* and *n*.

No. 38.*



I have repeatedly observed these insects running amongst the chaff or husks on the ears of wheat in great abundance, in every stage of growth, with the larvæ of the wheat-midge in June; in August in company with the *Aphides;* and in July, on opening some barley-straw (fig. 7, a portion split longitudinally), to investigate the economy of the *Chlorops* and its parasites, I found groups of the orange-coloured larvæ (fig. *o*) and the perfect black *Thrips* (fig. *p*) between the spathes, and the former were also secreted in the ears amongst the incipient grains. Mr. Kirby remarked that "of all the insects that are found in wheat the *Thrips physapus*, in all its states, is by far the most numerous. I do not recollect examining a single ear in which it was not to be found; and my opinion still remains unaltered, that it derives its nourishment from the grain." †

As Mr. Kirby's letter to Mr. Marsham, dated August 27, 1795, comprises all that is at present known relative to the injurious effects of the *Thrips* upon the corn crops, I shall transcribe the most important passages: ‡—"I examined a great number of ears, and in them found this insect in all its states, between the *interior valve* of the *corolla* and the grain. It takes its station in the longitudinal furrow of the seed, in the bottom of which it seems to fix its rostrum; probably sucks the milky juice which swells the grain, and thus by depriving it of part, and in some cases perhaps the whole, of its moisture, occasions it to shrink up, and become what the farmers in this part of the world (Suffolk) call *pungled*. If your correspondent in Hertfordshire means the same insect, he is mistaken in asserting that only a single grain in an ear is injured by it. I have myself seen ears in which a *fourth part* of the grain was destroyed, or materially hurt. I have frequently seen two of the insects upon a single grain, and am told that sometimes more are observed. What is singular, when I met with them on the grain in the *imago* state, they were often in *pairs*, one of which was *apterous*. These

* Figs. 1–4, in the above woodcut, represent *Thrips minutissima*, which infests the potato, and will be described in a future chapter.

† *Linnean Transactions*, vol. iv. p. 239. ‡ Ibid. vol. iii. p. 246.

I take to be the sexes. I once found a large species, *ano aculeato* (*Thrips aculeata*, Mus. Kirby), in which the same distinction takes place. The larva of *Thrips physapus* is yellow, has six legs, which, with the antennæ and head, are black and white. Sometimes it is all yellow. It is very nimble in its motions, and although brought away in the grain soon makes its escape. The *pupa* is whitish, with black eyes, and wings apparent. It is very slow and sluggish in its motions." "There was an orange-coloured powder in every grain in which the insect was found, which I imagine is its excrement. All the farmers that I consulted respecting it agreed in saying that it did most mischief to the *late*-sown wheats, and that such as were sown early received little or no injury. This I think very probable; for when the grain is arrived at a certain degree of hardness and consistency (which perhaps was the case with the early-sown wheats before the insect made any material attack), I suppose it is not liable to be hurt. Linnæus says of this insect, 'spicas secales inanit;'* but nobody seems to have apprehended the injury it is capable of doing to wheat. An intelligent farmer, who first pointed it out to me, assured me that he was firmly persuaded that it was this insect which occasioned what was called the blight last year, which was the cause of so defective a crop. The part of one field that I examined, and which was particularly injured, was to the north of a high hedge: but the above-mentioned farmer informed me that he had found them plentiful in a very *open* country. To me they appeared more injurious in the *heavy* than in the *light* lands. Last year the bearded wheat (called by our farmers *clog-wheat*) escaped with the least injury; but this year, as far as my information and observation went, it was the most injured. I observed in one or two instances the *Forficula auricularia* upon the ear; and upon examining the grain, each time, to which it had applied itself, I found upon it the *Thrips*. Query:—Does it not devour them?" "The only method which can be serviceable to prevent the ravages of this insect is to sow the wheat early. It is probable that it does considerable damage *every* year, as it is a very common insect. Nor do I imagine that it has been more injurious than usual in the present year, only the scarcity has excited people's attention to everything that might hurt the grain."

We may just observe, that as the earwig is now well known to feed upon vegetable substances, it seems doubtful that it renders any service in reducing the numbers of the *Thrips;* but as it is also reported to feed upon *Aphides*, this interesting question requires to be more fully investigated. The red dust which was supposed to be the excrement of this insect was no doubt the

* That is, "it empties the ears of rye."—Linnæus, *Syst. Nat.*, vol. i. pars. 2, p. 743.

minute fungus called rust, &c.* At the period when the above letter was addressed to the secretary of the Linnean Society great scepticism seems to have existed as to the insects having injured the crops. In such matters we can often only draw our conclusions from analogy, and there can be no doubt from the mischief which is done to the foliage of melons, cucumbers, &c., by another species of *Thrips*† that the *T. cerealium*, called, it must be remembered, by Mr. Kirby, *T. physapus*, exhausts the juices of the wheat, and causes the grains to shrivel; and probably the abortion of a portion may be traced to their puncturing the tender straw at the joints.

It only remains to observe of this pest, that it is frequently attacked by parasites and other enemies, one of which is an *Ocypete;* and *Thrips cerealium* is often covered with the small white mites that are found in damp hay,‡ which feed upon the insect.

APHIDES OR PLANT-LICE.

The corn crops do not escape the visitations of this extensive tribe; indeed, what crop does? We have already seen several species swarming upon the turnips, and another often destroys the fairest prospects of the hop-grower in a very short space of time. Mr. Markwick, whom we have so frequently mentioned, found the *Aphides*, or *dolphins*, as they are called in some counties, infesting the wheat-ears in the second week of July, 1797. Mr. Kirby also reported this *Aphis* to be sufficiently common upon barley and oats as well as wheat in the same year; and as Fabricius has given no description of his *Aphis avenæ*, which is possibly the same species, Mr. Kirby was constrained in describing it to designate it by a new name.§ This insect belongs to the order HOMOPTERA, the family APHIDIIDÆ, the genus APHIS, and the species is called—

6. *A. granaria.*—It is green when alive, changing to an olive ochreous or brown colour when dead: the antennæ are very slender and tapering, as long as the body, inserted close to the inner margin of the eyes, in front of the face, composed of seven black joints, more or less ochreous at the base; first joint stout and ovate; second sub-globose; third very long; fourth and fifth decreasing in length; sixth not longer than the first; seventh very slender, and as long as the third: head fixed, small, transverse oval; eyes lateral, remote, dark and globose; ocelli three, forming a large triangle, one being placed near the inner margin of each eye, the third upon the anterior margin of the forehead: trophi forming the rostrum or mouth, arising at the lower part of the face, between the anterior coxæ; under lip not much longer

* See Professor Henslow's report in the *Journal of the Royal Agricultural Society*, vol. ii. p. 9.

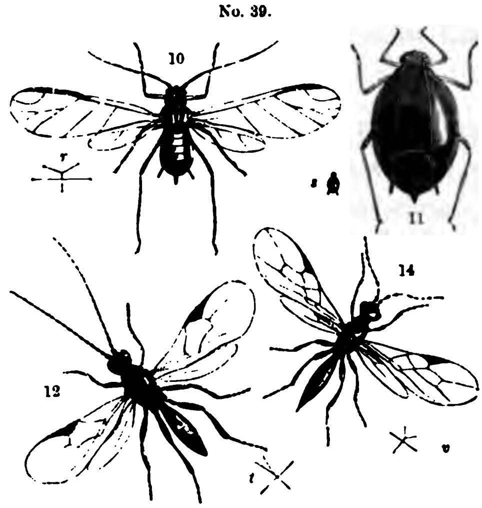
† *Gardeners' Chronicle*, vol. i. p. 228.—*Thrips ochraceus.*

‡ *Entomological Magazine*, vol. iv. p. 144.

§ *Linnean Transactions*, vol. iv. p. 238.

than the head, four-jointed, pointed, black, ochreous at the base, inclosing two maxillæ and two mandibles, which form an exceedingly slender, horny, long tongue: thorax moderately large, globose, the disk dark, collar much narrower; scutellum semicircular: abdomen stout, oval, with two slender black tubercles or tubes on each side of the antepenultimate joint, furnished with a horny process at the apex in the female: wings four, deflexed in repose (fig. *r*), transparent, iridescent; superior very ample, twice as long as the body, stigma long and green, the costal cell rather small and somewhat oval, the furcate apical cell small; inferior wings much smaller, with two oblique nervures. *Females* often apterous: legs long, slender and green, with short hairs on the tibiæ; thighs black, except at the base: shanks black at the apex; tarsi bi-articulate, of the same colour, with two minute claws. Plate J, and No. 39; figs. 10, the male magnified and represented flying; figs. *r*, the natural size.

No. 39.



On the 12th of July, 1842, I detected many of the apterous *Aphides* amongst the chaff of the wheat ears, apparently sucking the stem; they were brown and shining. And in looking over some wheat fields at Cranford with Mr. Graham (in the middle of August, 1845), we found numbers of the *Aphides* in every stage of growth, from minute ones that were just born to the full-sized and winged parents. I observed that all which had not arrived at their last stage had shorter legs than the others; the largest ones were of a dull orange colour; the antennæ, except at the base, the eyes and abdominal tubes, the extremity of the tibiæ and the tarsi were black, and the thighs pitchy towards their apex (Plate J, fig. 11; *s*, showing the natural size). With them were multitudes of dead *Aphides*, whose history I shall now relate.

Opportunities have repeatedly been afforded us, in the course of these investigations, of showing the wonderful ways by which Providence has provided agents to restrain the ravages of noxious insects, which, without such checks, would frequently render man's greatest efforts abortive; and as there is no tribe of insects more subject to parasitic enemies than the *Aphides*, we may reasonably infer—indeed, it is proved by experience—that when such checks are withheld, our crops will suffer severely from the superabundance of insect tribes. The wheat ears in the above year afforded a beautiful illustration of the economy of parasitic insects, and the benefits resulting from their agency. On some wheat which we examined not a single *Aphis* had escaped the searching vigilance of its enemies, and the husks were spotted with immoveable black shining globules. On a closer examination, it was evident that these were *Aphides* which had been punctured by minute parasitic flies, and that, as they increased in bulk, the little internal maggots thrived upon their fat until the *Aphides* died from exhaustion, their bodies being gummed by a natural secretion to the chaff and stalks, their antennæ and legs remaining just as they were during life, and likewise retaining their natural colours. I placed these infested ears in a box; and after a short time I bred from them two distinct species of parasitic flies, as well as a third from another wheat ear, all of which I will now describe.

They belonged to the order HYMENOPTERA, the family ICHNEUMONIDES ADSCITI; and the first to the genus APHIDIUS: the species is named by Mr. Haliday—

7. *A. avenæ.**—In the *male* the antennæ are dull black, filiform, compressed, inserted in front of the face, scarcely so long as the body, and composed of twenty joints, the two first forming an oval shining mass: head and thorax smooth, shining black, the former transverse oval; eyes rather small, and somewhat lateral; ocelli large, forming a triangle on the crown: thorax with a double channel down the fore part of the disk; collar very short and narrow; scutellum semi-ovate; postscutellum and abdomen with a few whitish hairs as well as the thighs; pedicle rather long, narrow, rugose, and black, the base ferruginous; abdomen brown, smooth, shining, and shuttle-shaped, the margin of the segment next the pedicle and a suffused patch on the back ochreous: wings transparent, iridescent, and pubescent; superior with a large cubital internal cell, imperfectly closed externally, and producing two rudimentary nervures only; all the posterior marginal and the radial cells wanting; stigma large, yellowish brown, forming a thickened costa towards the apex: legs subferruginous; all the coxæ and thighs, excepting the first pair, pitchy; their tibiæ clouded with the same colour; tarsi five-jointed and blackish, basal joint considerably the longest in the hinder pair; claws minute; pulvilli longer (figs. 12; *t*, showing the natural size).

This was produced from a large testaceous female *Aphis* found upon an ear of wheat in the middle of July (Plate J, fig. 13; *u*, the natural size). It made its exit near the tail, as shown in the figure. We learn from Mr. Haliday, that whilst the male *Aphidii* are hovering over the plants infested

* *Entomological Magazine*, vol. ii. p. 99.

by the *Aphides*, the female is engaged in laying her eggs, which she effects by bending her body under her breast; and by lengthening her tail, the ovipositor is conducted under the *Aphis*, and an egg is instantly inserted in its belly near the tail. She then searches for another suitable victim, passing by all those which have been already inoculated.

From the dead female *Aphides* of a black colour (No. 39, fig. 11; *s*, the natural size), I bred an allied insect, named by Mr. Haliday* and Nees ab Essenbeck†—

8. *Ephedrus plagiator.*—*Female* clothed with a few pale scattered hairs: antennæ black, filiform, considerably shorter than the body, eleven-jointed, two basal joints small, third the longest, following elongated: head and thorax black and shining, the former transverse oval; eyes small, somewhat lateral; ocelli three in triangle on the crown: thorax gibbose ovate; collar short and narrow; scutellum semi-ovate; pedicle long, narrow, and rugose; abdomen small, shuttle-shaped, smooth shining brown; the base and disk ochreous brown, apex furnished with two slender horny pointed lobes: four wings transparent, iridescent, with a slightly smoky tinge; nervures brown, superior with a long, yellowish brown stigma, the costal nervure extending to the extremity of the radial cell, which is large and perfect; there are also three complete discoidal cells, and the external cubital cell is nearly perfect: legs ochreous, four hinder thighs and the tarsi pitchy, tips only of the first pair fuscous (No. 39, fig. 14; *v*, the natural size).

This little insect is exceedingly like the preceding one; but there are fewer joints in the antennæ, and on comparing the wings it will be seen that the nervures are different, and the cells more numerous. It has also been remarked by Mr. Haliday, that the *Ephedrus* pierces the *backs* of the *Aphides* to deposit her eggs, whereas the *Aphidius* punctures the *under side* for the same purpose.‡ I cannot refrain from remarking the singular fact, that so few males are found in some species of *Aphides;* and amongst the horny punctured ones, not one of that sex have I detected upon the wheat. The services of this minute parasite are thus rendered more effective, as the prolific females not requiring sexual intercourse for several generations, the destruction of one individual of that sex prevents many thousands from making their appearance in the course of a few months.

The third species of insect I bred does not destroy the *Aphides*, but infests the *Ephedrus*. It belongs to the family PROCTOTRUPIDÆ or OXYURI, and many years since I described it under the name of—

* *Entomological Magazine*, vol. i. p. 486.
† *Hymenop. Ichneu. affin. Monog.*, vol. i. p. 16.
‡ *Entomological Magazine*, vol. i. p. 486.

9. *Ceraphron Carpenteri.**—It is black and shining; head and thorax finely punctured and clothed with minute hairs. The *male* has a broad head; the eyes are lateral; ocelli three on the crown in a curved line: antennæ inserted near to the mouth, longer than the body, eleven-jointed, geniculated, bristly and serrated; basal joint elongated, second minute, third and five following obtrigonate, the internal angles pointed, the remainder elliptical: thorax obovate, as broad as the head, with three longitudinal striæ; scutellum ovate; metathorax with the hinder angles toothed: abdomen smaller than the thorax, very shining, ovate conic, depressed, attached by a broad but very short pedicle, composed of seven joints, the first covering more than half the body, the base striated: four wings transparent, pubescent, very iridescent; anterior with a thick pitchy costal nervure, terminating beyond the centre in an oval horny stigma, from which issues a longish curved ray: legs pitchy, tips of anterior thighs with their tibiæ, and the base of the other tibiæ, bright ochreous; tarsi more or less ochreous brown, five-jointed, basal joint long; claws and pulvilli distinct. *Female* larger; the antennæ scarcely so long as the body, not serrated nor hairy, but clavate and eleven-jointed; basal joint longer than the head, second and third of equal length and slender, two or three following obtrigonate, the remainder slightly oblong, the apical joint conical: abdomen as large as the thorax, and acuminated at the tip, composed apparently of two horizontal valves.

I bred one male and several females from the wheat ears, and these select those *Aphides* which have been already occupied by the parasitic *Ephedrus*, in whose larva the female *Ceraphron* deposits an egg, and thus the maggot of the destroyer is punished with death in its turn. Here we see a countercheck is provided to prevent the too great multiplication of the legitimate guardian, and thus indirectly the *Ceraphron* assists in preventing the extinction of the plant-lice.†

There is a little apterous *Cimex*, of a bright scarlet colour, which is frequently very abundant in corn fields, and appears to me to be the larva only of a species of bug. I expect it lives upon the *Aphides*, or some other of the injurious insects, as in all probability it is carnivorous; but I am at present ignorant of its economy. It is this insect, I apprehend, which Somerville alludes to.‡ He supposes the blight called *hungry pickles* by dealers to be attributable to insects; but whether the shrivelled appearance of the grain

* Curtis's *British Entomology*, fol. 249 and dissections in Plate 249; Curtis's *Guide*, Gen. 581, 7; and chapter iii. of this volume.

† It is said that the beautiful scarlet Acarus named *Trombidium holosericeum*, Fabr., injures the spikes of corn in France. It is often abundant in the corn fields of England, where they resort, it is affirmed by Mr. F. Walker, to subsist upon the *Aphides*.

‡ Dickson's *Practical Agriculture*, vol. i. p. 556.

and the empty husks of the wheat, in very wet seasons, be caused by them, or by the presence of the blight named by Dickson *Uredo frumenti*, I am unable to decide. It is clear, however, that Somerville has confounded two distinct insects, as we shall see by his statement. He says it strikingly resembles a louse, being of a bright red colour, soft and tender; it then assumes a dirty black tint, becomes stationary, and continues so till it dies, when it is hard.* In 1782, when the crop was very late, and the season very wet and cold throughout, the wheat crop, he says, almost entirely failed from the depredations of this insect; and it has always been in such seasons that it has been deficient. When the crops have been early they have been least affected, and the plant has attained sufficient vigour before these insects appear to resist their influence; and if it be the delicate rostrum of the larva that causes the mischief, it would not penetrate the hardened stem, husks, &c., and, he adds, on such they seemed to die of hunger, or remove from them. After the grain has passed the milky state, it is safe from their attacks. Such mischief has always been done to crops not perfectly covered after sowing, or when the seed is very near the surface, whilst such as are deposited at a greater depth almost wholly escape.† From the errors already pointed out, it is impossible to draw any correct conclusions from the foregoing observations. It is only from the most accurate data that we can hope to derive beneficial results.

When we found the *Aphides* in August, three other insects were flying over and alighting upon the wheat. I shall allude to two of them briefly, in order to direct attention to their economy. One was a saw-fly called *Selandria humeralis*,‡ of which there were several; another was a beautiful little green parasitic fly, with black feet, which was running over the ears; it belongs to the family *Chalcididæ*, and is an *Entedon*.§ The third was so abundant that Mr. Graham took many of them on the wing; and as in all probability it lives upon the larva of some insect infesting the corn, I will describe it. It is related to the species lately alluded to in this volume, which is parasitic on the *Chlorops tæniopus*;‖ it consequently belongs to the order HYMENOPTERA, the family ICHNEUMONIDES ADSCITI, and forms a portion of the genus DACNUSA, I believe;¶ and being uncertain of its specific name, I propose calling it, from its inhabiting corn fields—

10. *Dacnusa cerealis*.**—*Male* slender, black, and shining; head rather small and sub-globose; eyes orbicular; ocelli three in triangle: antennæ as

* This is no doubt the punctured *Aphis* (No. 39, fig. 11), which he has confounded with the scarlet bug.

† See Dickson's *Practical Agriculture*, vol. i. p. 556.

‡ It belongs to the *Tenthredinidæ*, and is nearly allied to the *Athalia spinarum* produced from the nigger caterpillar; see chapter ii.

§ Curtis's *Guide*, Gen. 620.

‖ *Cœlinius niger*, chap. viii.

¶ Haliday's *Hymen. Brit. Fasciculus*, ii. p. 5.

** It is the *Ganychorus ambulans* of Haliday. See Curtis's *Guide*, Gen. 551^b, 6.

long as the body, filiform, composed of twenty-one joints, pubescent and fuscous, the three or four basal joints bright ochreous; first joint oval, truncated obliquely; second small, globular; third long; fourth, and following, decreasing in length: thorax elongated, gibbose before; scutellum rugose, with elevated lines, the sides striated; postscutellum rugose, with three elevated lines forming a trident on the back; the pedicle is elongated, narrowest at the base, depressed, striated, and pitchy brown: abdomen rather short and slender; the apex clavate, brown, excepting the basal joint, which is ochreous brown, and the belly is of a similar but a paler tint: four wings very transparent, beautifully iridescent; nervures very pale reddish brown, as well as the stigma, which is elongated; radial cell perfect and reaching to the apex: two complete discoidal cells, all the posterior ones imperfect: legs long, slender, and bright ochreous; tarsi five-jointed, their tips and claws black: length, 1¼ line; expanse, 3 lines.

Corn-Bugs.

We have now arrived at some insects belonging to the *Cimicidæ*, or tribe of bugs, which are abundant in corn fields, and probably live upon other insects that injure the crops. Mr. Kirby describes one in the *Linnean Transactions*,* which he found very common upon the wheat, in all its states, with the wheat-midge, but he could not discover that it devoured it. The larvæ, pupæ, and perfect insects were at the same time upon the straw and ears; for, like the plant-lice or *Aphides*, this tribe is active, and resembles its parents in its larva and pupa states. These bugs belong to the order Hemiptera, the family Coreidæ, and the genus Miris of Fabricius. The specific name, owing to its being attached to the wheat, is—

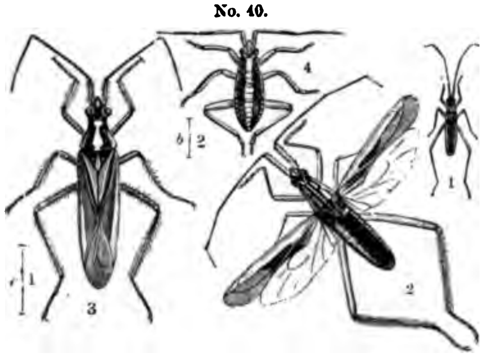
11. *M. tritici.*† —*Male* tawny ochreous, long and narrow; antennæ longer than the body, inserted before the eyes, setaceous, pubescent, and four-jointed, parallel at the base, the first joint stoutest, blackish at the base beneath, forming a stripe outside, second twice as long, third much shorter, fourth the shortest and fuscous; the rostrum is inflected and almost half as long as the body, four-jointed, blackish at the tip: head subovate, the centre a little projecting, and leaving two shoulders for the insertion of the antennæ; it is sulphureous, with a deep channel at the base, a large slate-black patch on the crown, and a spot on each side of the base of the same colour; eyes small, oval, lateral, and prominent; ocelli none: thorax oblong, narrowed before, the hinder angles rounded, sulphureous, with two black lines down

* Vol. v. p. 110.

† Curtis's *British Entomology*, fol. and Plate 701, where twelve species are referred to. A figure of the male is represented flying, and dissections are given.

the centre, and one on either side tapering behind; scutellum moderately large, ovate trigonate, acute, and slate-black, with the edges and a line down the middle sulphureous: abdomen flat, linear, and margined, obtuse at the apex, slate-black above, silky gray beneath: elytra or superior wings coriaceous, considerably longer than the body, linear in repose, pale sulphur-coloured, the interior portion brown, with a slate-coloured stripe on each near the base, leaving a pale costal margin; membrane fuscous, with an elliptical cell at the base; inferior wings ample, folded in repose, with several faint brown nervures, transparent, very iridescent: hinder legs very long; four anterior thighs spotted with brown beneath; shanks simple, slender, and hairy; feet tri-articulate, basal joint the longest and stoutest; second rather shorter than the third; claws slender and simple (No. 40, fig. 1; 2, the same flying, and magnified). *Female* similar to the male, but shorter and broader, entirely of an ochreous tint, excepting the black abdomen, which is conical and ochreous at the apex, with a long suture beneath to receive the ovipositor; the reflexed sides are orange-coloured; the antennæ and legs are a little stouter and shorter.

No. 40.



I have often met with this *Miris* upon grasses in marshes, in the vicinity of the sea coast, in company with *M. erraticus** of Linnæus, of which it may be only a variety.

Another species is exceedingly abundant in barley fields, and upon the long grasses in flower on their borders. Towards the end of June, 1845, there were multitudes of the pupæ and imago in the fields surrounding Wilton and Salisbury: they are, in all probability, carnivorous, and consequently the farmer's friend, but we have not been able to trace their economy to its source. This insect belongs to the same order, genus, and family as the last; and I gave it the specific name in the *Guide* of *picticeps*, from its painted head; but after collecting a series of specimens, I am inclined to believe that it is only a variety of the Linnean species called—

12. *Miris dolabratus*.—The *male* is sulphur-coloured, pubescent: head small, black, somewhat lozenge-shaped, a little narrowed behind the eyes, which are lateral, prominent, oval, and brown; the forehead is a little pro-

* *British Entomology*, fol. and Plate 701; and Curtis's *Guide*, Gen. 1099.

duced, with a yellow dot on each side of the face, an orange streak on the forehead, and a yellow margin to the eyes above; ocelli none; rostrum long, slender, four-jointed, piceous at the tip: antennæ not so long as the body, setaceous, pubescent, four-jointed, piceous or tawny, parallel at the base; first joint the stoutest, a little longer than the head; second more than twice as long; third shorter; fourth not so long as the first, and very slender: thorax trigonate, truncated before, twice as broad as the head behind, orange-coloured before, with two broadish stripes of a purplish colour, black before, leaving a pale lateral margin: scutellum larger than in *M. tritici*, triangular, orange-coloured at the base, with four black spots and two on the disk, the edges being of the same colour: abdomen obtuse, fuscous above, ochreous beneath, with a brown stripe down each side, leaving the margins ochreous: elytra coriaceous, longer than the body, elliptical, rather broader than the thorax at the middle, lying flat on the back, the disk of a rosy tint; membrane fuscous, with a large elliptical cell at the base: wings ample, fuscous: legs similar to the last, but not so long; tarsi fuscous at their tips: fig. 3; *a*, the natural length of 4½ lines; breadth, 1 line. *Female* shorter and broader; the elytra not longer than the abdomen: antennæ and legs much stouter and not so long as in the male, the pubescence upon them thicker and black: the back of the abdomen and the stripe on each side beneath often of a reddish purple colour; the channel to receive the ovipositor convex, and not so long as in *M. tritici:* length, 4 lines; breadth, 1½ line. The *pupa* is not 3 lines long, boat-shaped, destitute of wings, and of a bright yellow colour; the legs and antennæ are rather stout, and most like those of the female in both sexes; they are ochreous, often clouded with purplish red: the eyes are black; on the crown of the head is a balloon-shaped figure of a chestnut colour: the thorax has a broad stripe on either side of the same tint, which runs along over each sheath of the wing-cases down to the tail, which is obtuse in the male and ovate conic in the female, the under side is variegated with reddish purple: tarsi only bi-articulate; blackish at the tips (fig. 4; *b*, the natural length).

M. dolabratus also abounds on grass, in hay fields, in June, and is to be met with until the month of September; it is sufficiently different from *M. tritici* in the form of the head, thorax, and scutellum, to establish a second section in the genus *Miris*.

Oscinis granarius.

I am also indebted to Mr. F. J. Graham for another enemy to the wheat crops. It will be remembered that I lately described and figured a fly called *Oscinis vastator*, which hatched from maggots living in the stems of wheat.*

* See chapter viii. Plate H.

A grain of that corn, from its rosy colour, attracted Mr. Graham's attention in the summer of 1845, and being secured in a box, it produced a little black fly closely allied to *O. vastator*, but it may be distinguished from it by the base of the shank being black, instead of ferruginous; neither is it the ***Musca frit*** * of Linnæus, which I doubt not is a *Chlorops*.

On examining the grain of wheat, I found the farina squeezed out accidentally, possibly in picking it from the ear; it was of a pink colour, and from amongst it protruded an empty shining pupa-case of a rusty ochreous colour: from this had issued a fly belonging to the order DIPTERA, family MUSCIDÆ, and the genus OSCINIS, and as I cannot find it described, I shall call it, from its feeding on the grain—

13. *O. granarius.*—It is black and shining, with a greenish cast: the head is transverse, semi-orbicular; the antennæ are black and orbicular, with a short pubescent seta; the eyes are large, remote, and oval; ocelli three in triangle on the crown: the thorax is nearly quadrate; scutellum semi-globose: abdomen of *female* ovate conic, apparently five-jointed: two wings transparent, iridescent; the nervures dark, and exactly like *O. vastator;* two balancers, with a large ochreous white club: legs black, (?) the first pair is lost; four posterior, with the basal joint of the tarsi, dirty ochreous, and tip of the intermediate tibiæ of the same colour.†

I regret my inability to give any better history of this little fly, but I trust this sketch may lead to a knowledge of its economy, should it ever appear in any abundance. It is, moreover, interesting, as it shows how insects of the closest affinities vary in their habits of life, and it is only a practised eye that can in many cases detect the differences of allied species.

MILLIPEDES OR FALSE WIREWORMS.

Before dismissing the insects attacking the wheat, I must not forget to state, that in November, 1844, I had some plants sent me which had been sown, and had made shoots from ½ to 1 inch in length, when they died, owing, it was believed, to their being infested by a millepede called *Polydesmus complanatus*, which was lately figured and described in this volume.‡ There was every appearance of their being the culprits, for they swarmed round the grains, which were much injured and fast decaying; the only question is, whether they fed upon the grain before or after it became in a sickly state.

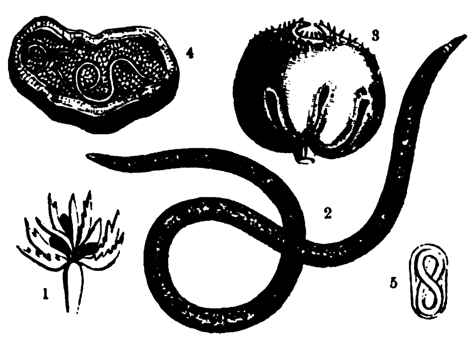
VIBRIO TRITICI.

Although neither the *Millipedes* nor the *Vibrio* belong to the same *class*,

* See chapter viii. † Ibid. woodcut, No. 35, figs. 1–4.
‡ See chapter vii. Plate G, fig. 55.

they are so intimately connected with insects, in affecting the crops, that I could hardly complete this portion of my subject if I did not include them in the present chapter; and as it is many years since the history of the *Vibrio* was published in the *Philosophical Transactions*,* and that work may be inaccessible to many agriculturists, I am induced to introduce sketches to illustrate its economy from the inimitable drawings of the late Mr. Francis Bauer, deposited in the Banksian Library of the British Museum; and they will prove the more acceptable from Professor Henslow having included the *Vibrio* in his "Report on the Diseases of Wheat," in the *Journal of the Royal Agricultural Society*.†

No. 41.



The minute worm which causes the disease called *ear-cockle*, or *purples* (No. 41, fig. 1), belongs to the class INFUSORIA, and has been named—

14. *Vibrio tritici*.—The eggs are taken up by the sap from the infected grain which may have been planted, and hatch in the stalk ‡ as well as in the germen. The largest worms are $\frac{1}{4}$ inch long at least, of a yellowish white colour, and not so transparent as the young worms (fig. 2, magnified); "their heads are very distinct; they have a kind of proboscis, which has three or four joints, which they contract or extend like an opera-glass. From the head, which is somewhat roundish, they taper gradually off towards the tail, which is scarcely half the diameter of the middle of their body, and ends in an obtuse, claw-like point. At a short distance from the end of the tail is an orifice, surrounded by an elevated fleshy edge; from this orifice the worms discharge their eggs. The back of these old worms is nearly opaque, and appears jointed or annular; the number of joints or rings is from twenty-five to thirty; the belly side is more transparent, and strings of ova can be distinctly seen through almost the whole length of the worm to the orifice by which the eggs are discharged." Those in the cavities of the mature grain are generally $\frac{1}{38}$ or $\frac{1}{36}$ inch long, milk-white, and semi-transparent. After laying all their eggs, the parent worms soon die, and in a few days they decay and fall to pieces, but such is

* The Croonian Lecture, read before the Royal Society, Dec. 5, 1822, and published in 1823, in the first volume of their *Transactions*, being "Microscopical Observations on the Suspension of the Muscular Motion of the *Vibrio tritici*," by Francis Bauer, Esq., F.R., L.S. and H.S.

† *Royal Agricultural Journal*, vol. ii. p. 19.

‡ Mr. Bauer thinks this may be another species of *Vibrio*.

not the case at an earlier period of life; for after being dried and appearing quite dead, on the application of moisture they become as lively as they were at first: and thus for five years and eight months Mr. Bauer was able to reanimate the worms by immersion, but it required a longer period as the time lengthened, and after that they died: other examples bred by him retained their revivescent qualities for six years and one month. It seems probable that the glutinous substance in which they are enveloped preserves their vitality. They may be kept alive for three months in water.

It appears from Mr. Bauer's investigations, that the cavities of the grain are at first filled with a white fibrous substance, formed by gluten into balls of a silky nature. In water they instantly dissolve, and exhibit hundreds of minute worms, which become animated in less than a quarter of an hour when moistened, and the grains eventually assumed a dark brown colour, and were as hard as wood (fig. 3).

Nothing is known regarding the sexes, and it is extremely probable the *Vibrios* are hermaphrodite. In some grains approaching maturity, only one worm was found with the cluster of eggs, in others there were three (fig. 4, the section of a grain, exhibiting some worms and multitudes of eggs). The eggs come forth in strings of five or six together, and are detached in water: the young worms can then be seen through the transparent skin (fig. 5). In about an hour and a half after the egg is laid in water, the young worm begins to extricate itself, which it took one of them an hour and twelve minutes to accomplish.

Such are some of the leading points in the economy of this extraordinary little animal noticed by Mr. Bauer; and for further information I must refer the reader to his valuable paper, and to Professor Henslow's interesting report.

SUMMARY OF THE FOREGOING CHAPTER.

Parasitic flies living upon the wheat-midge, *Cecidomyia tritici*, and upon each other.

Platygaster tipulæ, found during summer months, deposits its eggs in the maggots of the wheat-midge. It is exceedingly abundant.

It lays only *one egg* in each maggot, passing by those previously inoculated.

Females in swarms, *males* very seldom seen.

A second species in corn fields, called *Platygaster tritici;* and there is a vast number of other species.

Platygaster (?) inserens lays its eggs in those of the *P. tipulæ*, and limits its increase.

Macroglenes penetrans is also occupied in the same way, but lays its eggs in the maggots of the *Platygaster tipulæ.*

Flies called *Empides* carry off and devour the wheat-midge.

A little insect called *Thrips* accused of injuring the corn crops.

Some species destroy *peaches* and *melons, cucumbers, olives,* and hot-house plants.

Thrips cerealium destroyed one-third of the wheat crop in the richest plains of Piedmont in 1805, and it is believed affected the same crops in England.

It causes the *rye* to be unprolific in *Scotland,* and also in Sweden.

The *larvæ* and *pupæ* are similar to the *perfect Thrips,* but the first is of an orange colour, the others are black, and the female only has wings in her last stage.

Abundant in summer in the *ears* and between the *leaves,* at the base, in *wheat* and *barley* plants.

It is the most *numerous* of all the insects infesting the wheat, and common every year.

Pungled, or shrivelled grains, caused by the *Thrips* extracting the milky secretions, and abortion frequently occurs from their piercing the tender straw at the joints.

One *fourth part* thus *destroyed* in some ears.

Orange-coloured *larvæ* very active, *pupæ* indolent.

The orange-coloured *powder* often accompanying them is not their *excrement,* but a *fungus* called *rust.*

They do most *mischief* to *late-sown* wheats, the *early-sown* being too *hard* to suffer from their attacks.

Apparently more *injurious* on *heavy* than on *light* soils.

In some years the *bearded wheat escaped,* in others it has *suffered most.*

Earwigs with them. Do they live upon the *Thrips?*

Minute as the *Thrips* is, it is infested by a *parasite,* and is often covered with *mites,* which feed on it.

Aphides, or plant-lice, called also *dolphins,* infest the *wheat* in July and August; when they are in every stage of growth.

Aphis granaria also inhabits *barley* and *oats.*

Every *Aphis* sometimes *punctured* by a parasite, and the *ears* exhibiting numbers of *brown* and *black globules* scattered over them.

Aphidius avenæ lays her *eggs* in the body of the apterous *Aphis,* which then becomes *brown.*

Ephedrus plagiator deposits her eggs in a similar way in the apterous *Aphides,* which assume a *black* colour.

Very few *male Aphides* to be found, and the *punctured* ones are all *females.*

Ceraphron Carpenteri destroys the parasitic *Ephedrus,* by depositing its eggs in the maggots, which are already living in the *Aphides.*

Trombidium holosericeum supposed to injure the spikes of corn in France, but they resort there to feed upon the *Aphides.*

A little apterous *bug,* of a *scarlet* colour; abundant on corn. It is *carnivorous,* and possibly lives upon the *Aphides.*

Hungry pickles supposed to be caused by this or some other insect by Somerville.

A fungus, called *Uredo frumenti,* makes its appearance at the same time.

Such mischief arises from *shallow sowing,* according to Somerville.

A saw-fly, named *Selandria humeralis,* an *Entedon,* and *Dacnusa cerealis,* flying about a wheat field in August; the last in abundance.

Miris tritici, a bug, abundant on the wheat with the *Aphides,* in the larva, pupa, and perfect states. Does it live upon the plant-lice?

It also abounds on *grasses* in marshes on the *sea-coast.*

Miris dolabratus equally common upon *barley* and the borders of the fields, in every stage, where it is in all probability serviceable in destroying noxious insects.

It is exceedingly numerous in *hay fields* around London from midsummer to Michaelmas.

A little fly called *Oscinis granarius* appears to live in the grain of *wheat* in the larva state.

One bred from a *pupa* issuing from a *kernel* of a *rosy colour.*

A millipede called *Polydesmus complanatus* in abundance about grains of *wheat* which had *vegetated* and *died.*

Were they the cause or effect of the disease?

The worm named *Vibrio tritici,* infesting the grains of wheat in the ear, which are then called *ear-cockles* or *purples.*

Eggs absorbed from the soil with the *sap.*

The *female* worm *dies* after laying her *eggs.*

When *dried and dead, moisture reanimates* the worms, and their *vitality* has *not* been *extinguished* for upwards of *six years.*

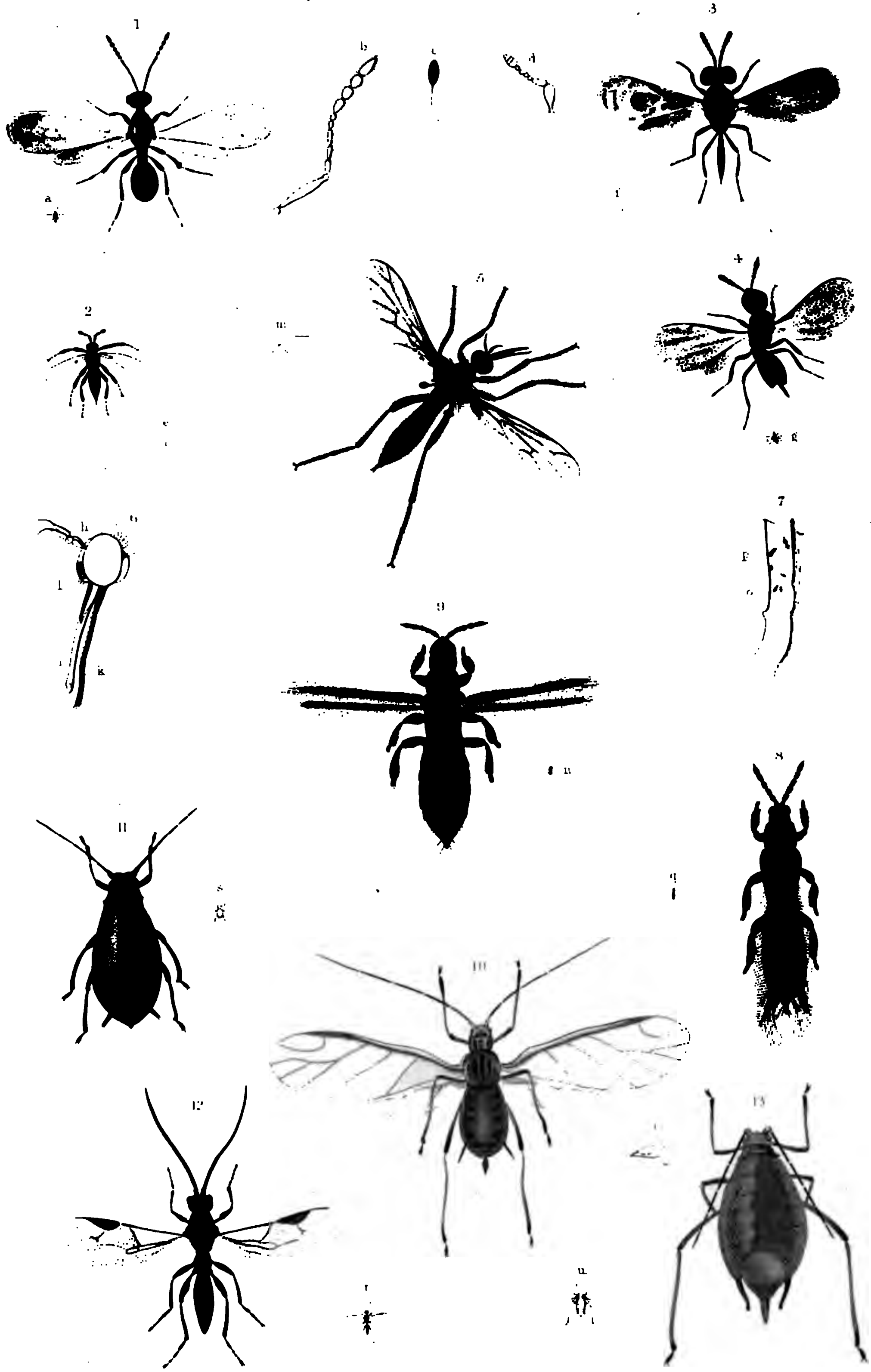
The *glutinous substance* in which they are enveloped probably secures their *vital* powers from destruction.

The *cottony substance* which at first fills the *grains* is composed of hundreds of these *worms,* which become active in a quarter of an hour on being moistened.

The *grains* finally become hard and *dark.*

GRAIN CROPS.

Parasites of Wheat-Midge, Wheat-thrips and Plant-lice, infesting Corn Crops.



They are believed to be *hermaphrodite.*

The more matured grains contain innumerable eggs, with from one to three worms only in each.

The *eggs* are laid in strings of five or six together, and the young worms can be seen through the skin.

The *young worms hatch* about an hour and a half after the *eggs* are *laid,* when put in water, and they are almost as long in extricating themselves.

Explanation of Plate J.

Fig. 1.* *Platygaster tipulæ,* male.
 a, The natural size.
 b,* The antenna.
Fig. 2.* *Platygaster inserens.*
 e, The natural length.
 c,* The abdomen and ovipositor.
 d,* The antenna.
Fig. 3.* *Macroglenes penetrans,* male.
 f, The natural dimensions.
Fig. 4.* *Macroglenes penetrans,* female.
 g, The natural size.
Fig. 5.* *Empis livida,* female.
 m, The natural dimensions.
Fig. 6.* Head of the same in profile.
 h,* The two antennæ.
 i,* The upper lip.
 k,* The under lip.
 l,* The palpi or feelers.
Fig. 7. Portion of a stem of barley exhibiting—
 o, Larvæ of the *Thrips.*
 p, The *Thrips* itself.
Fig. 8.* *Thrips cerealium,* female.
 q, The natural size.
Fig. 9.* The same flying.
 n, The natural size.
Fig. 10.* *Aphis granaria,* male.
 r, Natural size, walking.
Fig. 11*. An apterous larva.
 s, The natural size.
Fig. 12.* *Aphidius avenæ,* male.
 t, The natural size.
Fig. 13.* Case of *Aphis granaria,* female, from which the *Aphidius* had hatched.
 u, The natural size.

Those numbers and letters with a * attached, refer to the objects which are represented larger than life. All the figures are drawn from nature, excepting 2, *c* and *d,* which are copied from the *Linnean Transactions.*

CHAPTER XI.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE CORN CROPS IN THE FIELD AND GRANARY, INCLUDING MOTHS, WEEVILS, AND OTHER BEETLES, ETC.

BEFORE I take up the history of the insects that infest housed corn, it will be necessary to record a few species that attack the standing crops, which have not at present been noticed, and this I will do as briefly as possible.

SCOPULA FRUMENTALIS AND PYRALIS SECALIS—*the Corn Pyralides.*

The first moth is a native of Sweden and other parts of Europe, where it inhabits wheat fields in June. It was named—

1. *Pyralis frumentalis* by Linnæus, but it is now incorporated with a section of that group, called *Scopula.* It expands about 1 inch: the palpi are minute, the horns very slender, the eyes prominent; the thorax is moderately stout, as well as the abdomen; "the superior wings are shining, pale ashy green above, with two or three oblique whitish bands, with linked oval spots; the posterior margin is ciliated with alternate white lines; under side of wings grayish green." *

Linnæus and Rolandi † also describe an allied species called—

2. *Pyralis secalis*, which lives in the caterpillar state in the stems of rye, eating within the sheath, and migrating from one to another, rendering the ears white and empty. This moth, which I have captured in the end of May and the end of June in the south of France, has gray-brown striate wings, with a kidney-shaped spot inscribed with a Roman A. ‡ Dr. Turton says the larva is green, with three brown lines, and a reddish head, which is very similar to one I shall immediately describe. I wish, however, to state that I have examined the cabinet of the Linnean Society, and find that a specimen of the *P. secalis*, with Linnæus' autograph label attached, is identical with the species figured by Duponchel as the *P. frumentalis* above described, but of which I could find no specimen in Linnæus' cabinet. Treitschke and

* Linnæus' *Faun. Suec.*, No. 1351.

† *Act. Stock.* for 1752, p. 62.

‡ Linnæus' *Syst. Nat.*, vol. ii. p. 882, No. 338.

Duponchel affirm that Hübner's figure of *P. repandalis* is the female of *S. frumentalis*.

These moths are not at present recognized as natives of this country, but they may eventually make their appearance; for in the beginning of March, 1846, I received from Alton in Hampshire some wheat plants; the blades looked sickly, and in the heart were larvæ of the *Oscinis vastator*,* and of a caterpillar of some moth answering to Turton's description; but not having reared the moths I cannot determine upon the species. My correspondent T. C. stated that a large portion of the field was patchy, and affected by these larvæ, yet in putting them into a garden-pot with a wheat plant they did not appear to feed. On the 8th of April, however, Mr. F. J. Graham of Cranford showed me some plants of wheat attacked by rust, and in one of the centre shoots was a caterpillar of the same species as the one from Alton. It lay with its head downward, and was about 8 lines, or nearly ⅔ inch long, about the thickness of a small crow-quill, of a pale green colour, with a rusty brown head, and two narrow stripes of the same tint down the back; it was furnished with six pectoral, eight abdominal, and two anal feet. I shall anxiously await the appearance of the moth.†

It appears that these caterpillars are attended by a parasite, the *Ichneumon secalis*, which lays its eggs in them. "It is the size of a louse," says Linnæus, "with a red head and beautifully green eyes; the thorax is entirely black, as well as the horns, which are filiform, but scarcely so long as the body; wings with a subrotund black marginal dot; abdomen ovate, black, smooth; petiole rough; aculeus as long as the body."‡ Fabricius describes this little fly as a *Diplolepis*,§ but to which genus of the *Chalcidites* it belongs I cannot determine.

LEUCANIA OBSOLETA—*the Antiquated Leucania.*

Hübner‖ figures this moth, which is one of the *Noctuidæ*, under the above name. It was considered formerly an exceedingly rare insect in England, and we are indebted to Mr. Samuel Stevens for a knowledge of its economy. He was so obliging as to send me several of the caterpillars in the third week in August, 1844. They generally undergo their transformations in fenny places amongst reeds, the leaves of which they eat; but having placed them in a cage with some fine oats coming into ear, I found they fed freely upon

* Chapter viii. and Plate H.

† These all died in the larva state, but Mr. Graham subsequently succeeded in rearing the moth, which proved to be *Apamea I-niger*. See chapter viii.

‡ Linnæus' *Faun. Suec.*, No. 1641.

§ Fabricius' *Syst. Piez.*, p. 152, No. 19.

‖ *Europ. Schmet. Noctuæ II.*, Genuinæ 8, Plate 48, fig. 233.

the leaves, notching the sides (No. 42, fig. 1), and it is therefore desirable to notice the fact and to record their habits. These caterpillars, like many others, only come out at night to feed; and although full grown by the end of August, they remain in the shortened stems of the reeds through the winter, and the moths emerge from the pupæ during the entire month of June. When the caterpillars have arrived at their greatest size they are often 1½ inch long (fig. 2); they are linear, not quite semi-cylindrical, smooth, of a flesh colour, the edges of the segments being of the deepest tint, and clouded with dull pale green: the head is pale brown, reticulated with deep brown, having two curved lines down the face, of the same colour; the first thoracic segment is short and shining, with three whitish longitudinal lines which extend to the tail, and are edged with pale green; the six pectoral, eight abdominal, and two anal feet are pale dirty green; the spiracles are pitchy, with a light centre; the head and tail are slightly hairy. When disturbed they curl up and fall down, but can walk very nimbly. When prepared to change to chrysalides in the spring, they leave the reed stubble, conceal themselves just beneath the surface of the earth, or draw together a few dead leaves or rubbish with a loose web to inclose the pupa, which is brown.

No. 42

3. *Leucania obsoleta* is of a satiny texture: the female is of a dull pale ochreous colour; the antennæ are bristle-shaped; the feelers form two short beaks; the eyes are brown when dead; the tongue is spiral, and about as long as the antennæ; the superior wings are freckled with black; the nervures appear whitish, and are margined with brown; between them are brown streaks terminating in a black point at the base of the fringe, and there is a curved line of brown dots beyond the centre: base of abdomen and inferior wings nearly white; the latter, with the nervures and the exterior margin, smoky, with a line of black dots along the base of the fringe: expanse of wings, 1½ inch. The male is smaller, and of a paler and clearer colour; the nervures are not so strongly marked, and there is a smoky streak from the base to the centre; the under wings are white, a little freckled and ochreous at the exterior margin; before the centre is a dark spot shining through from the under side, and beyond the middle is a line of four or five similar dots (fig. 3).

CRIOCERIS MELANOPA—*the Oat Crioceris.*

I have read of the gelatinous larva of a *Tenthredo** which causes the leaves of the barley to wither by feeding upon the upper surface, but have never met with it. I have, however, found a larva of a similar nature, which I expected would change to the *Tenthredo,* but to my great surprise it eventually produced a beetle; and as the economy of this species is unnoticed by authors, I will transcribe my notes. On the 18th and 20th June, 1842, I found on the leaves of some oats coming into ear in a field in the neighbourhood of Sherborne, Dorsetshire, some slug-like larvæ which had eaten the epidermis in longitudinal lines (No. 43, figs. 1). A small one was brown, mottled with ochre; it was very glossy, but looked slimy like a little slug; the minute head was black, and it had six small black pectoral feet; it was ovate or pear-shaped, being slightly narrowed towards the head (fig. 2). A larger specimen was more ochreous, and after being immersed in water for twenty-four hours it became perfectly of that colour: it then appeared transversely striated and wrinkled, with minute warts behind the head, which was brown; along each side was an elevated line of little brown bristly points; and the six feet were brownish towards their tips.† These larvæ feed down the leaves sideways, gnawing with their little mandibles an even line between the striæ, either above or below the leaf, leaving only the membrane, which often dries and cracks, making a hole of greater or lesser extent. In other instances they had occasioned ochreous spots where they rested, and where their old skins had been cast off, as they increased in size. I placed one in a box with some bits of earth, amongst which it formed a spongy whitish cocoon, irregular in form externally (fig. 3); but as I was not stationary at the time, its economy was probably interfered with, and the cocoon may be more regularly formed under natural circumstances. On the 10th of August I had the satisfaction to find in the box a specimen of *Crioceris melanopa,* a pretty beetle which is not uncommon in corn fields and on rushes from the middle of April to the end of

No. 43.

* This genus belongs to the same family as the *Athalia spinarum*. See chapter ii.

† It now resembled, in form, the larva of the asparagus beetle, *Crioceris asparagi,* which belongs to the same genus; see the *Gardeners' Chronicle,* vol. v. p. 592. Another species, *C. merdigera,* produces the larvæ which infest and render the white lilies of our gardens offensive.

September. It belongs to the order COLEOPTERA, family CRIOCERIDÆ, and the genus CRIOCERIS. The species was named by Linnæus—

4. *Crioceris melanopa.*—It is shining; the head is dark greenish blue, minutely punctured with a deep groove at the base; the face is concave; the mouth is pitchy; the eyes are black and prominent: the antennæ are twice as long as the thorax, subclavate, black and pubescent, excepting the basal joint, which is green, shining, and globose; second small; third and fourth obovate; the following compressed, broader, and obovate-truncate; apical joint conical: the thorax is reddish orange, often with two dusky spots on the disk; it is a trifle broader than the head, of an orbicular form, but the anterior angles are visible, and the base is contracted: scutellum blue: elytra elliptical, thrice as long as the thorax, and twice as broad, of a beautiful deep blue, sometimes with a slight greenish tint, and rarely black; there are ten lines of long punctures on each: the wings are ample; the under side is deep blue and punctured: the six legs are bright and deep ochreous: the trochanters black: the thighs are stout: the tips of the tibia are dusky, and the tarsi are black and pubescent; they are four-jointed, and cushioned beneath; the two basal joints are elongated, third bilobed, fourth the longest, slender, clavate, and furnished with two simple claws: length, 2 lines; breadth, $\frac{3}{4}$: fig. 4; 5, magnified. For dissections, &c., of the *Crioceris* consult the *British Entomology*, Plate 323; and in the *Gardeners' Chronicle*, previously referred to, the eggs, larvæ, &c., of *C. asparagi* are figured and described.

I have already given the history and drawings of the metamorphoses of a caterpillar * which feeds on the wheat when in ear, as well as after it is stacked or housed; and in October, 1845, I received from Mr. Graham of Cranford another caterpillar belonging to the family *Noctuidæ*, of somewhat similar habits. Mr. Graham sent me about a dozen of them from the refuse wheat in his barn after thrashing. They were nearly $\frac{3}{4}$ inch long, and several of them died from injuries they had received. I put them into a box with wheat and chaff, and they evidently fed upon the grain during the winter, and increased in size very materially, one being at the end of February 1 inch long, and as thick as an oat-straw. They were exceedingly active, and disliked the light, generally burying themselves amongst the corn as soon as the box was opened; and in turning round they doubled themselves very much, so as to form a loop, the head approaching the tail. They were semi-cylindrical, with six pectoral, eight abdominal, and two anal feet, of a dull ochreous red tint, and slightly hairy: there was an indistinct paler line down the anterior portion of the back, but it vanished behind, and each segment bore a V-

* *Caradrina cubicularis*, chapter viii.

shaped figure; the sides were darker, with apparently a pale oblique line on each segment, owing more to the light falling on the raised muscles than to colour, and the spiracle beneath each was black: the head is rather small and shining: the centre of the eyes is dark brown: the antennæ are distinct, the tips dark: all the legs are pale, dark at the apex, the hinder pair spreading, and with the rump are ochreous, having a greenish tint, and this last segment has a darkish dilated line down the back: the under side is also of a dull pale greenish colour. Two of these caterpillars spun loose webs, to which some of the grains and chaff were attached; but they died before changing to pupæ. Having, however, made a drawing of the caterpillar, I hope at some future time to ascertain the moth it ought to change to.*

Having now given the agriculturist an idea of the insects with which he has to contend in the field, I wish to turn his attention, as well as that of all persons engaged in the corn trade, to the various species which are destined to live upon the grain after it is stored away in barns and granaries; and if they were not principally confined to the latter, it would be a great inducement for stacking the corn. The ravages, however, made by these insects may be justly attributed, I expect, in the first instance, to the importation of foreign corn; and, secondly, to the same store-houses being employed for many successive years without any purification or attempt at cleanliness. We well know if our own dwellings be neglected, if the rooms are not aired, and the broom and brush be not frequently employed, that a house soon becomes a harbour for moths, beetles, spiders, earwigs, woodlice, and hosts of various insects which destroy our clothes and furniture, and soon render the rooms untidy. If such be the case in a neglected house, what can be expected in a large apartment shut up for months together, filled with articles on which numerous insects feed, under a regular and comparatively high temperature, badly ventilated, and where the walls and roof are never purified by white-washing, or the floor ever scrubbed with hot water? If it were desirable to breed the corn-destroying insects, more certain means could not be adopted than the practice, too often resorted to, of storing grain and malt; for as sure as the soil will produce nothing but weeds if crops be not sown, so sure will almost all seeds become the prey of insects if they be neglected, and are not appropriated in due time either to reproduce their kind or to be converted into food.

A very great evil results from bonding foreign corn; for owing to the regular and high temperature on the continent of Europe, especially in the southern states, insects generate with more certainty and in greater multi-

* The caterpillars retained by Mr. Graham underwent their transformations, and eventually produced the *Noctua* (*Caradrina*) *cubicularis*.

tudes, and there is a larger number of species than in northern latitudes. In England there is not half the care required to preserve clothes, furs, collections of stuffed animals, insects, plants, &c., that there is in the south of France even, and no doubt the same law applies to agricultural produce; and it is this additional tax laid upon the inhabitants of warmer latitudes which has led to the general study of entomology, and to a high value being set upon scientific acquirements even by the legislature.* By importing foreign corn we also import foreign insects; and as they are not generally exposed to the changes of the climate when the corn is stored, especially in large masses, they live and multiply until an unusually severe winter or other casualties destroy them. It is very probable that some species may not be able to live for a single season in our climate, however sheltered they may be, but others no doubt soon become naturalized.

I have also long entertained an opinion that epidemics—*vegetable blights*, as they are termed—and noxious as well as other insects, gradually progress from the south-east, taking a direction more or less to the west or north, until they meet with so severe a check from temperature, that they gradually decline in virulence and power, and eventually become extinct for a lesser or greater period. This is certainly the case with some insects,† and the first species that falls under our notice seems to be gradually travelling northward. It has not at present, I believe, made its appearance in this country, and it will be fortunate for us if it never does.

BUTALIS CEREALELLA—*the Little Corn-moth.*

The little moth I allude to, whose scientific name is *Butalis cerealella*,‡ is called by the French "L'Alucita," or "Teigne des bles," or "Teigne des graines." It was first described by Reaumur; and from the ravages it has committed, its course has been noticed with intense interest by French agri-

* In France, Germany, and Belgium, local laws are from time to time enacted to enforce the destruction of insects; commissions have been appointed to consider the best means of arresting evils arising from insect agency: distinguished men have been deputed by the governments to visit districts suffering from the incursions of insects, and to report thereupon, and the publication of the most costly illustrated works has been the result. In many cases efficient plans have been devised for arresting the existing mischief, and in all cases the first step towards effecting any good has been secured by the attainment of an accurate knowledge of the economy of the noxious insects. I beg to refer the reader for further information to Kirby and Spence's *Introduction to Entomology*, vol. i. p. 171, first edition; p. 40, sixth edition; and p. 26, seventh edition.

† The locust, for instance, which occasionally reaches our shores from the south of Russia: *Sphinx nerii*, Curtis's *British Entomology*, fol. and Plate 626; the cockroach (*Blatta orientalis*); and numerous insects which exist in collections, and have not been seen alive in this country for many years.

‡ *Alucita cerealella*, Oliv., *Encyc. Méthod.*, vol. i. p. 121; *Œcophora granella*, Lat.; *Tinea hordei*, Kirby and Spence's *Introduction*, vol. i. p. 174, first edition.

culturists up to the present day. Dr. Herpin* says, "I have more grounds than ever to fear that the *Alucita*, which had somewhat disappeared during several years from our central districts, will show itself again in 1843 or 1844. I moreover fear that this scourge, which advances slowly from the south or west towards the north, will ere long penetrate into the fertile fields and the immense magazines of the Beauce. There will then no longer be time to avoid the most frightful disasters—famine and epidemics, which the *Alucita* brings after it. Imported into the Charente-Inférieure and Angoumois towards 1750, the *Alucita* was then propagated in the Aunis and Saintonge. About 1780 it commenced to spread itself in the Limousin; in 1807 it penetrated into the department of the Indre; in 1826 it invaded the department of Cher; it is now at the confines of the Beauce." † One may readily comprehend the dread expressed by our continental neighbours at the approach of this insect, when we learn from them that the infested corn loses forty per cent. of its weight in six months, and seventy-five per cent. of the farinaceous substance it contains.

The following history of this moth has been principally obtained from Reaumur.‡ It belongs to the order LEPIDOPTERA, family TINEIDÆ, and the genus BUTALIS of Ochsenheimer, according to Duponchel; but it agrees better, I think, with my genus LAVERNA.§ The caterpillars live in the grain of different kinds of corn, as wheat, oats, and maize, but principally in barley-corns. The female moth lays a cluster of twenty or thirty eggs upon a single grain, in lines or little oblong masses in the longitudinal channel; and this operation is performed in the field before the ears are perfectly matured, as well as in the granary: they are of a beautiful red orange colour. The caterpillars hatch in six or seven days after the eggs are laid, and sometimes in four only, and then they are hardly as thick as a hair. The first caterpillar which hatches penetrates into the grain, in a little spot between the beard and the appendage of the sheath, which is more tender than the rest; but the aperture is imperceptible, owing to the minuteness of the larva. Having taken possession of the grain, the remainder, as they escape from the shell, have to seek other grains; and when they find them unoccupied they pierce and enter them in the same way as we have described, so that each grain contains no more than one occupant; and this is sufficient to support the larva until it arrives at maturity, when it changes to a pupa within the grain, which is entirely emptied of farina, yet still to the eye

* *Recherches sur la Destruction de l'Alucite, ou Teigne des Graines;* published in Paris, in 1838.

† *Mémoire sur diverses Insectes nuisibles à l'Agriculture*, par J. Ch. Herpin.

‡ *Mémoires pour servir à l'Hist. des Insectes*, vol. ii. p. 486, Plate 39, figs. 9–19.

§ Curtis's *British Entomology*, fol. and Plate 735.

it appears a sound grain. If, however, it be taken between the fingers and pressed, it is found to be soft; and an experienced person can discover whether the grain contains a young larva or a pupa. By washing the corn the injured grain is readily detected.

This little caterpillar is very smooth and quite white; its head only is a little brown; it has sixteen legs, of which the eight intermediate and membranous ones are only like little buttons, and so minute that one cannot perceive them without a strong magnifying glass; and by the same means the ends of these legs appear to be bordered with a complete coronet of brown hooks. It is but little more than 3 lines long.

A grain of wheat or of barley contains the exact quantity of nutrition necessary to feed and support this caterpillar from its birth until its transformation. If a grain containing a caterpillar be opened when it is near to its metamorphosis, one sees that there is nothing more than the skin remaining: all the farinaceous substance has been eaten. The cavity contains, besides the larva, some little brown or yellow grains, which are its excrement; and as these are found to be less in bulk and number with the old than with the young caterpillars, it is concluded that they eat these deposits once or twice, as there is no aperture by which the excrement can be expelled. Having consumed all the flour in the grain, the caterpillar spins a white silken cocoon which lines the inside of it, or rather a portion; for the grain being divided longitudinally, and in two unequal parts, the smaller compartment is reserved for the excrement, which is pushed on one side.

Towards the end of November there are many caterpillars in the grains, and in spring almost always only pupæ. Some eggs must hatch much earlier than others, from the clusters which are deposited at the same time. The moths first make their appearance in some years in the commencement of May, in others in June, and again in November; but these live only two or three weeks at most. The moth makes its escape through a little round hole in the side of the grain, which the caterpillar cuts with its mandibles without displacing the stopper, before it spins its cocoon.

5. *Butalis cerealella* expands rather more than ½ inch: the head is smooth: the antennæ are setaceous, but appear a little beaded when magnified; the feelers are long, curved, and elevated; the basal joint is clothed with scales and shorter than the second, which is pointed: the proboscis is long, and very visible: the head, body, horns, palpi, and legs are of a light gray or coffee-and-milk colour: the superior wings are of the same colour above, with some faint blackish atoms at their extremity; they are straight, with the apex very pointed when deprived of the fringe; they form a rounded or depressed roof in repose, their extremities crossing one

another: the fringe, which is of a clearer colour, is also sprinkled with similar atoms along the internal margin: the under side of these wings is of a rosy shining brown; both surfaces of the inferior wings, including the fringe, are of a leaden gray.*

Reaumur mentions a parasitic fly which sometimes hatches from the grains containing the caterpillars or pupæ, to the number of twenty from one insect; and Olivier says, "One thing worthy of remark is that the moths which hatch in the month of May from the grains shut up in the granaries, hasten to get out by the windows and to gain the fields, instead of which those that come forth immediately after the harvest make no attempt to escape. It seems that their instinct informs them that they will then find no more provision in the fields for the support of their posterity." †

The foregoing account will enable those interested more readily to detect the presence of the little corn-moth, and the following remedies may be equally useful, if applied to other grain-feeding insects, even should we be spared from the visitations of the *Butalis*, which seems to have made its appearance in the United States of America, from specimens sent to Mr. E. Doubleday by Dr. Harris of Cambridge, New England. It may be as well to state, that the example I have carefully examined has black fore legs, and a black spot near the tip of the palpi, characters which I do not find recorded by the French naturalists.

It appears that, of the various attempts made to prevent or diminish the ravages of this moth, the most effective method is to subject the infested grain to the heat of an oven or a very warm room. It does not seem to be ascertained what degree of heat the grain can endure without losing its germinating powers, but it appears that it is preserved at above 70° Reaumur (about 190° Fahrenheit). It is not, however, so much the intensity of the heat, as its continued action for a certain period, which kills the caterpillars and chrysalides in the grain, so that from 45° to 50° during twenty-four or thirty-six hours produce more effect than 76° or 96° for one hour. The difficulty is to maintain an equal temperature throughout the operation, and to obviate this, two machines have been invented and called "Insect Mills." One, by M. Marcellin, Cadet de Vaux, is a kind of large iron cylinder for roasting (bruloir), as simple as the common ones for coffee; the other, by M. Terrasse Dubillon, is also a kind of roaster, but with many spiral concentrics into which the grains successively pass.‡

* Having no authentic specimen to describe, I have given the characters from Reaumur and Duponchel.

† *Encyclopédie Méthodique*, vol. i. p. 115.

‡ The foregoing and following facts have been copied from Duponchel's *Supplement to the Lepidoptères de France*, vol. iv. p. 444.

"The grain being put into the roaster, the instrument is turned over the fire like the coffee-roaster for five minutes; the grain is then withdrawn, the temperature being 57° Reaumur, and that it must be calculated at about 60°, through the loss of heat which it experiences from opening the door and introducing the thermometer. The experiments made by the commission named by the Agricultural Society of Cher (in France) with this machine, proved that all the larvæ contained in the grains were dead and dried in the prescribed time (fifty minutes); that these grains, afterwards placed by the side of those infested, have undergone no more fermentation, and have been no more devoured by insects; that they have suffered no more waste than the others continued to suffer; finally, that the entire grains which had been put into the roaster, have germinated as well as the other grains which had not been placed there.

"The commission of Cher has verified that the machine of M. Marcellin was thus able to prepare in one day, 120 common bushels (boisseaux*); that a man and woman, or two women only, were sufficient to work it; and that with the fuel employed the expense in the country amounted to three francs per diem, or to a demi-sous (less than a farthing) per bushel.

"The machine of M. Dubillon has produced the same results as M. Marcellin's with a little more saving in labour. From the entry of the grain to its exit from the mill it passes over 300 feet, and the first grain introduced has taken four and a half minutes to traverse this space: fourteen boisseaux have passed through in one hour, which gives 140 boisseaux in ten hours of work, or twenty boisseaux more than M. Marcellin's roaster. The consumption of fuel was not greater, and two persons equally sufficed to serve the machine, it consequently shows that the expense is a little less; but it must be observed that M. Marcellin's roaster is much more simple and cheaper than the complicated one of M. Dubillon, and is better suited to the pocket of the little cultivator than this last."

Simple friction promises to answer every purpose, as will appear from the following remarks made by Dr. Herpin: † —"I think I have made a discovery of a very easy and very economical process for destroying the *Alucita* (*Butalis cerealella*) in its different states. It is by means of an agitator or shaking-machine, similar to the vertical tarares, furnished with little wooden or iron wings, propelled with very great velocity (600 revolutions a-minute). The shakings and concussions which the corn receives in passing in this machine are so multiplied and so quick, that the eggs are broken or detached from

* A boisseau is rather more than an English peck; thus three boisseaux are equal to one English bushel, and 107 parts of a thousand over, or rather more than one-tenth.

† *Recherches sur la Destruction de l'Alucite, ou Teigne des Graines.*

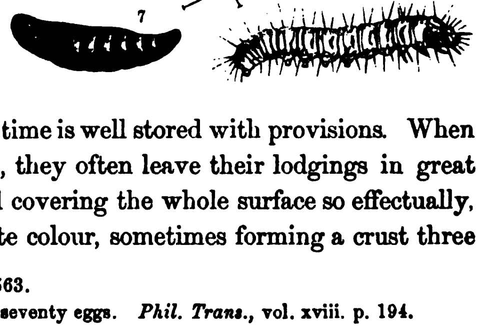
the corn; the insect is mauled and killed even in the interior of the grain where it is inclosed. I have not been able to make this experiment on a large scale, because I have not had a sufficient quantity of infested corn; but I have observed that some corn containing living larvæ of the *Alucita*, shaken briskly by the hand in a glass bottle for an hour, has produced only a small number of the moths, compared with that which came out of the same corn which had not been submitted to this agitation. I have thought it my duty to record this fact, and to publish it."

TINEA GRANELLA—*the Wolf, or Little Grain-moth.*

A moth, in some respects similar to the little corn-moth in its habits of life, is completely established in this country, as well as in every part of Europe. It is called in English works the "Mottled Woollen Moth,"* and it has received the scientific appellation of *Tinea granella*. The caterpillars do incredible mischief to bonded and housed corn laid up in granaries, and they are I believe called "White Corn-worms." From April till August the little moth is found in granaries and magazines, resting by day on the walls and beams, and flying about only at night, unless disturbed. Soon after they have escaped from the chrysalis the sexes pair, and the female lays one or two eggs on each grain of corn until she has deposited thirty or more: † they are so minute that they can only be detected by a good magnifying-glass, when they appear of an oval form and of a yellowish white colour.

The small white worms hatch in a few days (sometimes it is sixteen), and immediately penetrate the grain, carefully closing up the aperture with their roundish white excrement, which is held together by a fine web (Plate K, fig. 1). When a single grain is not sufficient for its nourishment, the larva unites a second grain to the first by the same web, and thus it ultimately adds together a great number (Plate K, and No. 44, figs. 2), forming a secure habitation, which at the same time is well stored with provisions. When the maggots are almost full grown, they often leave their lodgings in great numbers, running over the corn and covering the whole surface so effectually, with a thick web of a grayish white colour, sometimes forming a crust three

No. 44.



* Haworth's *Lepidoptera Britannica*, p. 563.

† Leuwenhoek says they lay from fifty to seventy eggs. *Phil. Trans.*, vol. xviii. p. 194.

inches thick, that scarcely a grain of corn is visible. It is considered that the object of this operation is to protect themselves from their enemies, as well as from transitions of the temperature. At this time the caterpillars are about 5 lines long (figs. 3), of a pale ochreous colour, composed of thirteen segments, with six pectoral, eight abdominal, and two anal feet: the head is horny, shining, and red brown, and there are four dark transverse marks on the first thoracic segment, being two sections of a circle broken in the middle: figs. 4, magnified. It is in August or September that the caterpillars have arrived at maturity, when they leave the corn-heaps and search for a safe and suitable place to undergo their metamorphoses, and at this period they are usually most observed. They form their cocoons (figs. 5) by gnawing the wood, and working it up with their web, in any chink in the floor, walls, or roof, which are frequently swarming with them, and these cocoons being the form and size of a grain of corn look like one dusted over. It there remains in its snug and warm berth, in the larva state, through the winter, and does not change to a chrysalis until the month of March following, and in a backward spring not until May. The pupa (figs. 6) is of a deep chestnut colour, the abdominal rings being of a shining yellow tint, and the apex is furnished with two little points (figs. 7, the same magnified). In two or three weeks after they have assumed the pupa form the moth hatches, with almost perfect wings at its birth, I have heard, leaving the empty chrysalis sticking half out of the cocoon: figs. 8.

This moth (figs. 9) belongs to the order LEPIDOPTERA; family TINEIDÆ; the genus TINEA, and bears the Linnean name of—

6. *Tinea granella.*—It is of a cream-white with a satiny lustre: the head hairy and tufted, concealing the eyes from above; these are hemispherical and slate-coloured: antennæ rather shorter than the body, setaceous, composed of innumerable subquadrate joints, pubescent, and clothed with depressed scales: tongue or spiral proboscis very short and scaly outside: maxillary palpi articulated, but very minute;* labial palpi long, scaly, drooping, divaricating, and tri-articulate, second joint the longest and stoutest, third more slender, elliptic-conical: thorax clothed with scales: abdomen linear and blunt at the tip in the male, in which sex the organ of generation is sometimes exserted like a fine long sting; the apex is conical in the female, with a telescopiform ovipositor: wings very much deflexed or sloping, like the roof of a house, with the fringe curved up in repose (figs. 9); superior longish and lanceolate, with many deep rich brown irregular spots, freckled between; there are six on the costa, the three nearest the base are the largest, the third semilunate,

* It appears to me that these organs are most fully developed in the females.

the two following minute, and on the inner margin is a brown oblong spot, forming an acute angle with the third; the fringe is long and brown, with pale stripes: inferior wings smaller, lanceolate, of a pale mouse colour, coppery towards the tips; the fringe very long and fine: six legs; hinder thighs very short; anterior shanks short, with a hairy spine on the inside, the others spurred at the apex; the posterior long, clothed externally with long hairs, having a second pair of long spurs near the base; tarsi longer than the tibiæ, slender, tapering, and five-jointed; claws very minute: expanse of wings, 5¼ lines: figs. 10, greatly magnified. The female is larger and darker. I cannot describe the trophi or organs of the mouth with the accuracy to be desired, owing to my not being able to obtain living specimens of the moth; but dissections of an allied species, very destructive to clothes, have been figured and described in the *British Entomology*, Plate 511.

It is difficult to guard against the introduction of this moth, since it deposits its eggs on the sheaves in the field, as well as after the grain is stored and thrashed out, and it will feed as freely upon barley, rye, and oats as upon wheat; and Leuwenhoek adds, "That these worms are not only destructive to corn, but are also in old timber, books, boxes, woollen stuffs, and the like." In reflecting upon the economy of this destructive animal, it is not difficult to suggest palliatives, if not remedies, and it appears to me that if the following rules were strictly attended to, few persons would suffer from the inroads of this insect:—

(1.) Before replenishing an empty granary or loft, the floor should be well scoured with hot water and soft soap, or lees, if practicable; if not, it must be well brushed with a fine stiff broom, to clean out the chinks or fissures between the boards. The roof and beams should be white-washed, as well as the walls, with lime-water, used as hot as possible; and these operations would have greater effect if performed in the winter months. I presume coal-tar would be even better, if the scent be not communicated to the grain. Sprinkling the floor with salt dissolved in strong vinegar has been recommended, and might be very serviceable.

(2.) In granaries already stored, where the caterpillars are at work, whatever method for their destruction may be resorted to, by heat, ventilation, or otherwise, it must be employed during the summer, from the end of May to the end of August; occasionally a month earlier or later, as during the winter these larvæ are not to be found amongst the corn-heaps; they retire in the autumn, to conceal themselves in fissures and cracks in the floors and walls, and form their cocoons.

(3.) The moths themselves might be destroyed in April and May, when they deposit their eggs, by burning a very powerful light, even in the day-time, in dark granaries; for being attracted by the brightness of the flame, they would fly into it and be destroyed, or fall down sufficiently injured to prevent their doing any further mischief,* and at the same time the corn ought to be frequently turned over with shovels, to kill the eggs and disturb the young larvæ.

To complete the work, all cracks and broken places in the walls and roof must be stopped with Roman cement or plaster of Paris, to prevent the ingress of the moth, and the apertures left for light or ventilation must be covered with wire gauze. It is a great mistake to leave the inside walls and roof in a rough state, as they afford exactly the retreats fit for the transformations of the larvæ; it would therefore be very advisable to have them smoothly plastered.

When the larvæ are securely feeding in the grain, one of the best remedies is to subject the whole to a sufficient degree of heat to destroy the insects. This is said to be best effected by kiln-drying, as a temperature of 19° of Reaumur (about 78° Fahr.) will kill the larvæ; but it can only be applied to corn intended for the mill, as it destroys the vital principle so that it will not germinate.† The great object in this process is to obtain the required heat as speedily as possible, and to let the vapour escape through apertures made for the purpose, in order that no unpleasant odour may be communicated to the corn.

Having so far shown what may be accomplished by heat, I wish now to turn the reader's attention to what has been proposed to be effected by an opposite process, which may be termed the *cooling system*. It being ascertained that the larvæ of the corn-moth cannot live in a lower temperature than 12° or 10° of Reaumur—namely, under a temperate heat—that they become torpid in a temperature of 6° or only 8° *above* zero, and that they die if this low state be maintained for any length of time, Dr. Hammerschmidt‡ has proved by repeated experiments, that by keeping up an artificial cold atmosphere, by means of ventilators, a sure remedy is effected. This is easily done by making small windows in all directions, near the floors of the storehouses, which will supply the current of air required. If the tubes be introduced through the closed windows, one end being carried into

* A contributor to the *Gardeners' Chronicle* says, "Would not a few gas-lights kept burning in the granaries, during the months the perfect insect is on the wing, prove both attractive and destructive of this pest? Lamps would not do, as they would soon be extinguished by the dead moths."—Vol. i. p. 133.

† Such is Kollar's statement in his *Natur. der Schæd. Insecten*, p. 128, but surely it must be incorrect, as the French assert that sixty degrees of Reaumur will not injure the germination of the corn, and it is liable to a much higher temperature than nineteen degrees in the open field.

‡ *Kollar*, p. 128. I may here acknowledge my obligations to this useful work, and the translation, for many of the foregoing observations relative to the *Tinea granella*.

the corn-heap, a draught will be created which will at once reduce the temperature sufficiently to attain the desired object; or the tubes may be laid in the floor with the end rising a foot above it, and covered at the top with a perforated rose, like that of a watering-pot: over these the corn must be thrown, to receive the cooled draught thus created.

Fumigation has been also recommended by M. Granier, who explained his method of preserving corn for long periods before the Academy of Sciences at Paris. "The corn was well winnowed, and put into a vessel or room perfectly free from damp; the external air was excluded, and then sulphuric acid was introduced by means of burning sulphur within, as is done in this country for whitening peeled wicker-wares. If many insects should be found to be destroyed by this method, pulverized charcoal should be mixed with the corn, to obviate the effects of putrefaction. M. Granier had kept corn six years perfectly good by a renewal of this operation once a year."* It is, however, positively stated that fumigation with brimstone has been found of no use, as it only induces the larvæ to bury themselves deeper in the corn-heaps.

Sprinkling the corn with common salt is considered very beneficial; indeed, Roësel says that salt powdered and mixed with the corn will kill the larvæ, or it may be dissolved in water and sprinkled over it; and it will not in any way injure the corn, as brimstone, wormwood, &c., do, by communicating a disgusting flavour. When there is room, it is a simple and successful plan to form a small heap of a bushel or two of corn near the centre, or the part most affected, and leave it undisturbed, whilst all the rest is to be turned over repeatedly, which will compel the larvæ to take refuge in the small undisturbed heap; and by pouring hot water over it, the insects can be readily destroyed: many will, no doubt, climb up the walls, but these can be swept off.

I must not omit to notice some interesting observations made in the *Introduction to Entomology*,† showing the extent to which this moth is multiplied in our granaries, and the serious consequences that might arise from neglecting to take timely measures for its extirpation. It is true that the facts in some degree contravene the modes that have been recommended to expel this pest: nevertheless, my advice to those who are sufferers is, to persevere. It appears that in October, 1837, the extensive granaries of Messrs. Hellicar, in Bristol, the greater part of which had been built within the two previous years, were infested by these insects. Mr. Spence, who visited the premises with Mr. Raddon, says—"We found the barley lying on the floors

* *Literary Gazette*, Aug. 1, 1840.

† By Kirby and Spence, vol. i. p. 140, 6th edition; and 7th edition, p. 94.

covered with a gauze-like tissue, formed of the fine silken threads spun by the larvæ in traversing its surface, on recently quitting it for the purpose of undergoing their metamorphosis in the ceiling of the granary, formed of the joists and wooden floor of the story above. What was remarkable, as Mr. Raddon communicated to the Entomological Society,* was the great depth to which the larvæ had bored in the wood—even through knots filled with turpentine, so as to convert portions of the wood-work in places quite into a honeycomb, and thus to be almost as injurious to the building as to the corn stored in it." It is certainly very strange that these larvæ, after being glutted with the farina of the corn, should wander from the heaps to feed upon timber, even saturated with turpentine. Such, however, is the fact; and Mr. Spence adds, "that their main purpose (whether we suppose the excavated wood to be eaten and digested or not †) is to provide a retreat for the larvæ, which remain in this state the whole winter, and do not become pupæ till spring, is proved by the fact that it is from the mouths of these holes (after every portion of the excrement hanging from them has been swept away, and the whole ceiling thickly lime-washed, as it is every autumn) that the moths emerge by thousands in the month of June, as yearly takes place in Messrs. Hellicar's granaries." Some of these caterpillars ate through paper into the cork where they were placed.

If diseased corn be used for seed, it is important to sow it deep, for the caterpillars will become pupæ in the earth; and it has been observed that when that practice has been adopted, few of the moths were able to struggle through the soil, and those were in a weak and languid state; whilst the corn which was buried about an inch only, with the larvæ in it, produced the moths, which readily made their escape from the chrysalides. It is also desirable to cut the corn in good season, and not suffer it to stand too long in the sheaf, as the moths will be enabled to lay their eggs in the ears in the field, and are thus introduced into the barn.

The natural enemies of the grain-moths are bats, which feed upon these and other moths, especially those that surround and inhabit the same localities. Spiders also occupy the angles of the windows and doorways, spreading their nets to catch such prey. The gray and yellow wagtails, and many other small birds, are insectivorous, and might be enticed to visit our barns and stack-yards by placing water conveniently for them; and, as Dr. Hammerschmidt observes, the excrement of the birds, which might easily be removed by winnowing, is not to be compared to the filth of the caterpillars for its injurious effects.

* See the *Transactions*, vol. ii. p. lxviii.

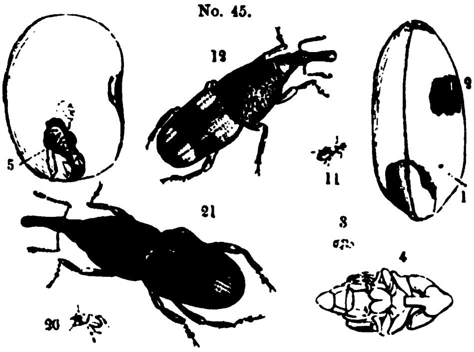
† See Leuwenhoek's statement in a preceding page.

The Corn-Weevils.

From the numerous statements and complaints that have been transmitted to me, I am inclined to believe that no insect does more mischief to stored corn, in England at least, than these weevils, of which there are two species, but neither of them are natives of this country, although one is perfectly naturalized. Probably the best plan will be to describe and figure these two species, then to relate their economy, and finally to investigate the remedies. These weevils belong to the order Coleoptera, the family Curculionidæ, the genus Calandra,* and one species is called by Linnæus—

7. *C. oryzæ*, the Rice-weevil (Plate K, and No. 45, figs. 11; figs. 12, magnified). It is smooth, elliptical, and somewhat depressed; some specimens are of a pale chestnut or ochreous colour, others are the tint of pitch, with every shade between the two extremes, regulated possibly by the age of the insect; the head is semi-ovate, the base smooth, and capable of being withdrawn into the thorax; it is sparingly punctured; the eyes are not at all prominent, but black, granulated, elliptical, and vertical; the space between them has a deep V-shaped groove, with a smaller one on each side; the fore part of the head is elongated into a stout rostrum or beak, twice as long as the head, nearly cylindrical, straight, smooth, and sparingly punctured; it is a little dilated at the base, with four grooves or lines of punctures, especially in the males, in which sex it is the stoutest; at the tip is the mouth, which is very minute, but composed of two horny mandibles, serrated so as to form four large teeth (fig. *a*); the maxillæ are minute (fig. *b*), terminated by an oval lobe, with a slender triarticulate palpus on the outside (fig. *c*); the horns are as long as the rostrum, and inserted on each side of it, close to the base; they are nine-jointed (fig. *d*); the basal joint is very long, and forms an elbow with the remainder; the second is subglobose, the third obovate, the four following are short, more or less cup-shaped, the remainder forming a stouter ovate-conic club, the basal joint being by far the largest; the thorax is twice as broad as the head, oval, but truncated at the base, with the angles rounded; it is suddenly narrowed before, at the base of the head, and the

No. 45.



* Schönherr, with his usual mania for superseding established names, has changed this to *Sitophilus*.

whole surface is covered with large deep punctures, leaving a smooth line down the centre, but almost uniting on the sides; the scutellum is minute and semi-ovate; the elytra are about as long as the head and thorax, not broader, oval, but truncated at the base, and sometimes narrowed a little at the middle; the dark specimens have four distinct orange-coloured spots, two on the shoulders and two near the tips, and there are regular rows of confluent deep little pits down the back, with lines of minute bristles between the alternate rows; the wings are ample, and folded under the elytra; the under side is coarsely punctured; the six legs are very strong, and rather short; they are also punctured, especially the thighs, which are stout; the shanks are short, slightly compressed, with series of minute bristles down the outside, and a short curved claw at the external apex; the tarsi can be bent quite back against the shanks, and are four-jointed; the third joint is bilobed, the fourth clavate and furnished with two minute claws: it is only $1\frac{3}{4}$ line long, and scarcely $\frac{2}{3}$ line broad.

I have often, in early life, found these beetles amongst rice, from which grain it receives its specific name *oryzæ*, and it no doubt was originally imported from the East Indies with that important article of food; but I have seen it infesting wheat from Ancona, sent to Mark Lane for sale in 1844, and from various granaries. Professor Royle also transmitted me specimens which were destroying East Indian wheat in the ships by which it was brought over to this country.

On cutting open the grains of the Ancona wheat, I found at the base of the kernel, in multitudes of instances, a cavity (fig. 13) containing a very small larva, curled up, of a dirty white colour, with a ferruginous horny head (fig. 14, *e*). This is the young grub of the weevil, and I have no doubt the egg is deposited by the female in this end of the grain, but I have never succeeded in obtaining the eggs or rearing the larvæ. I could not help remarking, that however sound the grains might appear outside in this sample, there were scarcely any that had not been perforated (fig. 15, *f*; and 16, *f*, the same magnified); and I could not find one in twenty that did not contain some of the beetles or grubs (fig. 17). The pupæ that I found *in situ* were all dead, and consequently not such perfect objects as I wished to delineate (fig. 18; *g*, the natural size): they are, however, like most weevil pupæ, of a yellowish white colour, and soft, with the rostrum, antennæ, legs, and elytra visible through the skin.

It is evident they are preyed upon by a parasitic hymenopterous insect, for in one of the grains I detected an apterous blackish green specimen, with rufous legs, but it was too much mutilated to draw from. I am pretty certain it is the same species, or closely allied to one, named *Meraporus gra-*

minicola,* which we often find in this country in July: fig. 19; *h*, the natural size.

The other species of corn-weevil alluded to received the name of *Curculio granarius* from Linnæus. It belongs to the same genus as the preceding beetle, and is now called—

8. *Calandra granaria*.—The granary-weevil is a little longer, and more smooth and shining than *C. oryzæ;* it is somewhat depressed, and varies in colour from a deep pitch to a dark chestnut tint; the head is semi-globose, produced anteriorly into a longish, smooth, cylindrical proboscis, which is shortest and stoutest in the male: it is slightly curved, and sparingly punctured, with two lines of punctures extending almost from the base of the head to the apex, forming two deep channels before the eyes, where the rostrum is dilated; on either side of these are one or two lines of punctures: the eyes are black, vertical, ovate, finely granulated, and depressed; the mouth, including the little strong jaws, maxillæ, and palpi, is placed at the extremity of the rostrum: the antennæ, which are as long as the rostrum, are inserted on the sides close to the base, they are nine-jointed; the basal joint is long, stout, and clavate; it forms an angle with the remainder, the second being subglobose, the third obovate, the four following more or less cup-shaped, the seventh being the largest, the residue forming an oval, conical, little shining club, pubescent at the tip; thorax twice as broad as the head, oval, a little truncated, and suddenly narrowed before, with a transverse impression; greatly truncated at the base, which is bisinuated: the surface is coarsely, not closely, punctured with oval points; scutellum minute and oval: elytra exactly equal to the thorax and head, occasionally a trifle broader near the base, being ovate-truncate, and not covering the apex of the abdomen; there are nine deep punctured channels down each, producing short pale bristles, and the two raised furrows on each side the suture have a line of long punctures; wings, none, or rudiments only: the under side is covered with exceedingly large punctures: the six legs are punctured, strong, and stout, especially the first and last pairs; the thighs are stout; the shanks are shorter and straight, the anterior are crenulated inside, and they all have a hook or claw at their extremities; the tarsi are reflexed and four-jointed, spongy beneath, basal joint subclavate, second ovate, third broader, slightly bilobed, fourth clavate, and furnished with two minute claws: length nearly 2 lines; breadth, ⅔ line: Plate K, and No. 45, figs. 20; and 21, greatly magnified.

It is remarkable that, whilst *C. oryzæ* has a pair of serviceable wings, *C. granaria* is destitute of the organs of flight, at least in this country.† I

* See Curtis's *Guide*, Genus 630 *f*.

† It is very probable that in warm latitudes these organs may be fully developed.

regret that I have no experience regarding the transformations of this species, for all my attempts to rear it have been unsuccessful. In June, 1844, I carefully examined some barley in a box, which I had procured the previous autumn; numbers of the weevils had hatched, and many were lying dead, but I could find neither eggs, larvæ, nor pupæ. Leuwenhoek and Olivier, however, will supply this deficiency; the former of these authors made many observations, which were published as long back as the year 1687, and the latter in the *Encyclopédie Méthodique.* It has been ascertained that, after the weevils had paired, the female made a hole in the grain of wheat with her rostrum, and deposited an egg in it (No. 45, fig. 1), from whence hatched a little maggot, which, during its growth, ate out the entire contents, and then changed to a pupa in the empty husk, and eventually the perfect beetle ate its way out: fig. 2, the holes of their exit. The maggot is nearly a line long, very white, soft, and elongated; the body is composed of projecting and rounded segments, and is furnished with a large, horny, round, yellow head, with teeth or jaws to nibble the substance of the grain. Only one maggot is found in each grain, as it is no more than is necessary to support it whilst it is in that state.* The pupa is clear, white, and transparent, so that one can distinguish through the envelope the rostrum, antennæ, and the other members of the insect: figs. 3; 4, magnified. In this state, of course, it takes no nourishment, but lies dormant, and only shows symptoms of life by moving its abdomen when it is disturbed. Eight or ten days after this metamorphosis, the weevil bursts the filmy skin in which it is swathed, and pierces the epidermis of the grain to form an aperture, and leave its prison: fig. 5, a kernel of maize magnified, with the beetle in its cell. It is the maggots which make the greatest havoc amongst the corn, yet it is evident that the weevils also feed upon it, as they are sometimes found, of a dark colour, inclosed in the grains.

It is well known that a certain degree of heat is necessary to invigorate these weevils, and induce them to copulate. If the temperature be under 8° or 9° (50° or 52° Fah.), the sexes have not sufficient energy to search for one another; they live in a state of repose, and even of torpor, if it be cold, and are then incapable of mischief. On the return of spring, especially in countries where that season is sufficiently favourable to raise the temperature to 10° (54° Fah.), the sexes pair; this happens about April in the south of France, and they go on propagating until the end of August; so that the destruction of grain is much more considerable in the southern than in the northern provinces. The warmer it is the oftener they pair, consequently the female lays her eggs every month when the heat is sufficiently great, but as soon as the mornings begin to be cold she ceases to lay; and such is the

* *Encyclopédie Méthodique*, vol. v. p. 488.

vast multiplication of this insect sometimes, in the granaries and magazines of France, that of a heap of corn nothing but the husks are left, and all kinds of grain are acceptable to the granary-weevil.

From the moment of pairing until the time when the weevil is hatched, occupies about forty or forty-five days, from which it is evident that there are many generations in a year, which, as we have shown, multiply more rapidly in a hot country. From a very curious table established upon the multiplication of the weevils, by adding together the number of each generation, the result obtained is a sum total of 6045 individuals, proceeding from one pair only of weevils during a summer, namely, during five months, dated from the 15th of April to the 15th of September, when the thermometer is above 15° (nearly 66° Fah.), and it never descends much lower in the southern provinces of France. As Olivier says, "One cannot be any longer astonished that enormous heaps of corn are sometimes so speedily devoured." As soon as the female weevil has been impregnated, she plunges deep into a heap of corn to lay and conceal her eggs immediately under the skin of the grains; she makes a puncture where it is slightly raised in this part, and forms a little elevation which is scarcely perceptible. These holes are not perpendicular to the surface of the grains, but oblique, or even parallel, and stopped with a kind of gluten the colour of the corn. The female never lays more than one egg in each grain, which is not long in hatching; and, when lodged in the grain, is perfectly secure from changes in the atmosphere, because the excrement that it makes seems to close the opening by which it entered, and even when the corn is removed, it is not incommoded by any shaking it may undergo.

It will be observed that the weevils are not found on the surface, but some inches deep in the corn-heaps; it is there that they live, very often couple, and that the females lay their eggs. Moreover, on looking at a heap of corn, one cannot detect the operations of these insects in the grains where they are lodged; they have the same form, the same appearance, they seem to be as large, as firm, as those which are not attacked: it is only by the weight that they can be detected, and on throwing a handful from a heap into water, the diseased grains will float. So long as the weather remains hot the weevils do not quit the corn-heaps they have invaded, unless they are obliged to abandon them from stirring the corn with shovels, or passing it through a sieve. When the mornings begin to be cool, all the weevils, young and old, desert the corn-heaps, which are no longer a retreat sufficiently warm for them; they retire into the crevices of the walls, into the cracks in wood and planks; sometimes one even finds them concealed behind the hangings, indeed, wherever they can find a safe abode that secures them from the cold, which makes them desert the granaries.

It is, however, wrong to suppose that the weevils remain in a torpid state during the whole of winter, to regain, on the return of spring, the corn-heaps which they have abandoned, and to commence laying eggs there. A general, if not a constant law amongst insects is, that those which have paired die soon afterwards, the males almost immediately, the females when they have performed their office of laying the eggs, and that they pass the winter in the egg or larva state. It is undoubtedly seldom that those which have not fulfilled the destiny of nature can brave the rigour of the season, and do not perish before the ensuing spring. The weevils seem to love darkness, and to remain undisturbed, since, when they are exposed to the daylight, they scamper off to conceal themselves. Such is Olivier's account.

There is one thing to be borne in mind regarding the corn-weevils, namely, that in this country at least they are never found in corn fields; the eggs are consequently not laid until after the wheat or barley has been thrashed out, and the *C. oryzæ* requires a much higher temperature to invigorate it than the *C. granaria* does; it is therefore only under very favourable circumstances, such as an unusually hot summer and mild winter, or in granaries naturally warm from local circumstances, or in the close holds of ships, that this species can cause any alarm in our temperate climate. It is in the East and West Indies far otherwise, and even in the south of Europe, as we have seen by the wheat from Ancona. Mr. Sells, who had resided in some of the West India islands, stated before the Entomological Society that "*C. oryzæ* was exceedingly abundant in the stores there, destroying great quantities of Indian corn and rice, and, to prevent its attacks, it was necessary to expose the grain to the sun, and to winnow it frequently."*

It is the *C. granaria* which does incredible mischief to our stored corn, as may be collected from the remarks already made, and barley and malt suffer the most from their inroads. I put these beetles into a box with barley, maize, beans, pease, and wheat, one autumn, and in the spring I found the barley was all eaten out, and a few grains of the maize were completely excavated, but the wheat, pease, and beans were untouched. On the other hand, in December, 1843, I received some *wheat* and black oats from Lynn, in Norfolk, in which the weevils abounded and had caused a great waste. The season suited to the propagation of the corn-weevils appears to be uninterrupted, for I have observed them in extensive flour-mills in Norfolk in the spring; in June and July they were abundant in the sweepings of a malt-house in Norwich; in September, and the three following months, in granaries, and during the winter they attacked and ate up some pearl-barley;

* *Transactions of the Entomological Society*, vol. i. p. lxxviii.

and at certain congenial periods the beetles may be seen in multitudes, even on the outside of granaries and malt-houses in London.

So important is this subject, that a variety of remedies have been successively proposed for many years, which I shall now consider; and although some of them may appear trifling, they will not only show how far advanced we are beyond our ancestors in such knowledge, but they may chance to elicit better modes of application, and even to suggest new ideas. We first hear of fumigation, with herbs having a strong and disagreeable odour; but this seems to have been useless, as the weevils, by burying themselves amongst the grain, are by no means incommoded, whilst the corn has suffered from fetid and disgusting scents which have been communicated to the grain. It is even asserted that the scent of spirits of turpentine appeared to cause the weevils no inconvenience; but I think if it had been persevered in for several consecutive days, excluding, at the same time, the ingress of air, that it must have destroyed them. The fumes of sulphur are said to be equally inefficient; and all these fumigations are still less adapted to destroy the larvæ, as the smoke cannot penetrate amongst the grain.

Olivier* also says—"Some have imagined, by putting the corn in pannelled cellars, or by sifting it in winter, the corn would be secured from the weevils; but this is a great mistake, for, independent of the difficulty of preventing its germinating and rotting, the weevils would be undisturbed, and more sure to commit their ravages. The sifting is likewise useless in winter, as the weevils have then left the corn-heaps; the eggs are also so well glued to the grain that it is impossible to separate them by sifting or stirring with the shovel. Experiments have proved that a sudden heat of 19° (about 75° Fah.) is sufficient to destroy the weevils † without burning them; but this would not suffocate the insects when they are buried in a heap of corn. It has been observed that a heat of 60° or 70° (167° or 190° Fah.) is necessary to kill the weevils in the stove; but this excessive heat, which has the advantage of destroying the eggs and larvæ inclosed in the grain, is capable of drying the corn too much, even of burning it, and yet does not preserve it from the insects secreted in the granary, which will come out and attack it if there be no other for them."

In a short communication to the *Entomological Transactions*, some valuable data upon this point are furnished by Mr. Mills, who was in Madeira

* These suggestions are translated from the *Encyclopédie Méthodique*, vol. v. p. 444.

† See note, p. 318. The discrepancies and attendant doubts regarding these subjects are fit inquiries to be made by some talented chemist and entomologist; but as the time such experiments and investigations require cannot be expected to be given by scientific men without remuneration, it is to be hoped that some plan may be adopted by the government, in this enlightened age, to settle such important questions, which would be doing an essential service to the country.

from January to August, 1835. In that island he thinks the eggs are first deposited whilst the maize is in flower, and he ascertained that he could hatch the eggs at 110° of Fah., whilst from 130° to 140° of heat killed them. He adds, "A gentleman of the name of Wilkinson, in Madeira, has now established a heated room with hot-water pipes, in which he receives as many as 800 bags of wheat at a time; these become heated through at about 135°, and the wheat, when resifted, is perfectly cleansed from these noxious insects, and makes quite as good bread as before. I also tried some of it in the ground that had been subjected to this heat, and it came up." *

Olivier then recommends a ventilator to introduce cold air, which has already been discussed in the remedies proposed for "the grain-moth," as well as the forming of little heaps of corn in the spring, to act as decoys. He says that when the weevils have taken possession of them, boiling-water should be poured on the heap, at the same time turning it over with a shovel, in order that the heat may penetrate everywhere: it ought afterwards to be spread to dry, and then sifted to free it from the dead weevils. This should be done at the commencement of spring, before the eggs are deposited, by which precaution a fresh generation is stopped.† The introduction of cold air is, I expect, to be recommended for various reasons: at Lynn in Norfolk I have heard it is the practice, and the readiest way of getting rid of the corn-weevils, to expose an empty granary to two or three nights' frost by setting all the windows open.

In a French work we are told‡ it is an excellent plan "to lay fleeces of wool, which have not been scoured, on the grain; the oily matter attracts the insects amongst the wool, where they soon die, from what cause is not exactly known. M. B. C. Payrandeau related to the Philomatic Society of Paris, that his father had made the discovery in 1811, and had since practised it on a large scale."

After all that has been said, I shall only revert to the necessity of keeping storehouses clean and aired, and I have the authority of gentlemen of great experience in London to state, that by stirring or turning over the malt frequently, and taking every opportunity of white-washing the walls whenever the granaries are at all empty, they experience no loss from the insects I have just recorded.

The corn-weevils are frequently accompanied by several species of small beetles, which assist in reducing the quantity and depreciating the quality of the corn in our granaries. Of course they all belong to the order COLEOPTERA,

* *Observations upon the Corn-weevils*, by William Mills, Esq., F.L.S.; *Transactions of the Entomological Society*, vol. i. p. 241.

† *Ency. Méthod.*, vol. v. p. 444.

‡ *Bulletin des Sciences Agriculture*, July, 1826, p. 24.

and the first is included in the family CORTICARIDÆ and the genus SILVANUS. It is named—

SILVANUS SURINAMENSIS—*the Corn Silvanus.*

From the specific name it may be inferred that this little beetle has been imported originally from Surinam. It is now a constant inhabitant of our stores and warehouses; and from its infesting corn, it was described by Fabricius as *Anobium frumentarium;* and subsequently as *Dermestes sexdentatum*, from the spines on the sides of the thorax. Linnæus's name having the right of priority, I shall retain it.

9. *S. surinamensis* (fig. 24) is only 1¼ line long (*k*), and very narrow: it is flat, of a rusty brown colour, thickly and coarsely punctured, and sparingly clothed with short, yellow, depressed hairs: the head is large and subtrigonate, the nose appears truncated, but it is semicircular in front, and conceals the mouth, which is composed of an upper and under lip, two little horny jaws, maxillæ and palpi: the antennæ are inserted under the reflexed sides of the head, stout, straight, pubescent, nearly as long as the head and thorax, and eleven-jointed, basal joint stoutish, second and third obovate, five following globose or cup-shaped, the remainder forming an elongated club, the basal and second joints being cup-shaped, the apical one more orbicular: the eyes are black, small, hemispherical, and coarsely granulated: the thorax is perfectly oval, and a little broader than the head at the middle; there are three ridges down the back, forming two broad channels, and on each margin are six teeth; scutellum minute: the elytra are long, elliptical, and broader than the thorax, with four slightly-elevated lines down each, between them are double rows of punctures, and series of little shining yellow bristles: beneath them are two ample wings: legs six, and short; thighs stout; shanks clavate; feet five-jointed, three first joints short, fourth exceedingly minute, fifth clavate, terminated by two claws.

The larva is a little depressed, yellowish white worm (fig. 22 magnified, *i* being the natural length); it is composed of a tolerably large head, with two pointed jaws and two little horns, and of twelve transverse segments; the tail is somewhat conical, and it has six articulated legs: the pupa (fig. 23, *j*, the natural length) is of the same colour; the head is bent down; the thorax is suborbicular with three ridges; the sides with a few short spines; scutellum elongated: elytra wrapped over the sides and striated: abdomen with distinct segments, the sides with short thick points like the thorax.

Mr. Ingpen bred this insect from bran he received from Scotland; and it appears to be naturalized, from its being found in various parts of England

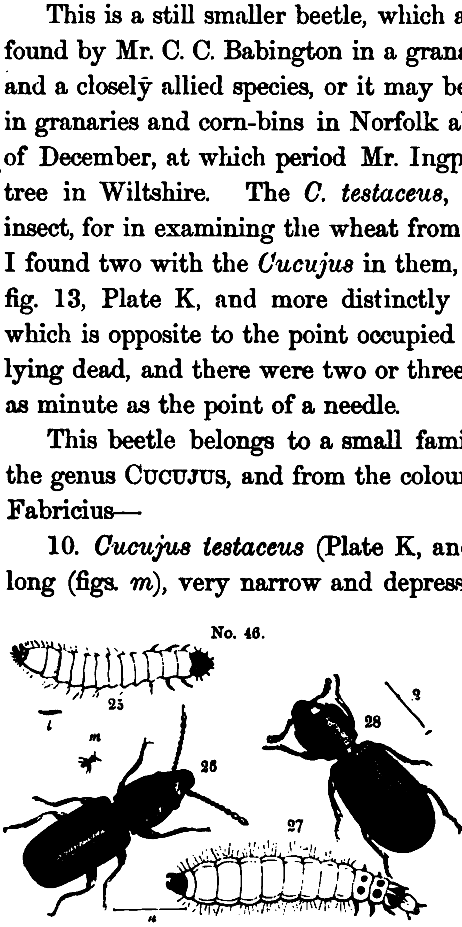
and Scotland under the bark of trees. It breeds in rice and divers kinds of corn; it also inhabits dried figs, and will feed on sugar.

CUCUJUS TESTACEUS—*the Corn Cucujus.*

This is a still smaller beetle, which accompanies the corn-weevils, and was found by Mr. C. C. Babington in a granary at Cambridge in great abundance, and a closely allied species, or it may be the other sex merely, was observed in granaries and corn-bins in Norfolk about thirty years back, in the month of December, at which period Mr. Ingpen detected it in an old decayed elm tree in Wiltshire. The *C. testaceus*, however, is decidedly a corn-feeding insect, for in examining the wheat from Ancona, and cutting open the grains, I found two with the *Cucujus* in them, as shown by the cavity at the top of fig. 13, Plate K, and more distinctly exhibited at fig. 14, *p*: in this cell, which is opposite to the point occupied by the corn-weevil, the *Cucujus* was lying dead, and there were two or three little holes in the skin of the wheat as minute as the point of a needle.

This beetle belongs to a small family called CUCUJIDÆ, which comprises the genus CUCUJUS, and from the colour of the insect it has been named by Fabricius—

10. *Cucujus testaceus* (Plate K, and No. 46, figs. 26): it is only 1 line long (figs. *m*), very narrow and depressed, finely but not thickly punctured, and clothed with short, soft, ochreous pubescence, and is of a bright shining testaceous colour: the head is broad, with a small black eye on each side towards the base; it is narrowed before, and to the nose is attached the labrum, under which are two toothed jaws, two maxillæ and palpi, and an under lip with two more palpi; before the eyes are placed



the antennæ, which are longer than the head and thorax, straight, moniliform, hairy, and eleven-jointed; basal joint stoutish and oval, the following more or less globose, the three last thickened, top-shaped, and forming a somewhat elongated club, the terminal joint having a little hairy tubercle at the tip: thorax rather broader than the head, somewhat quadrate, but a little narrowed behind, with the angles acute, the sides margined: scutellum small and transverse: elytra very much depressed, elliptical, often slightly concave, broader than the thorax and nearly thrice as long, concealing two ample folded wings: legs six, rather small, intermediate pair a little the shortest; thighs stout; shanks slender and simple, with a spine at the apex; tarsi very slender, five-jointed, first four joints very small, fifth long, clavate; the hinder pair is only four-jointed in the males; claws two.*

With them I had also the good fortune to find the larva (figs. *l*): it is a little longer than the beetle, narrow, very much depressed, of an ochreous colour, sparingly hairy, and formed of thirteen segments, including the head, which is somewhat orbicular, with two minute antennæ and two palpi; it has six pectoral, short, articulated legs, the segment at the tail is the longest, semi-ovate, recurved, and terminated by two little spines forming a fork: figs. 25, greatly magnified. I have never seen the pupa. Another species of *Cucujus*, apparently the *minutus* of Olivier, infests the maize.

PTINUS CRENATUS—*the Oval Ptinus.*

Another small beetle is often associated with these insects in old granaries, and by eating into the floors and rafters in which they breed, not only reduce the wood-work to powder, but prepare commodious retreats for the larvæ of the corn-moths and the grain-weevils. The mischief might be prevented, I expect, by kyanizing the timber employed in such buildings. This coleopterous insect belongs to the family PTINIDÆ and the genus PTINUS. From the difference of form in the sexes, the male was described as the *P. ovatus* and the female as *P. cerevisiæ* by our countryman Marsham, but it had previously been named by Fabricius—

11. *P. crenatus.*—It is of a rusty brown colour; the male is scarcely 1 line long and 3/8 broad; the female is sometimes 1½ line long and 3/4 broad; the head droops and is densely clothed with yellow hairs; the eyes are small, black, prominent, and lateral; antennæ long in the male, filiform, pubescent, and eleven-jointed, basal joint stout; the following elongated, terminal one conical; shorter in the female, the joints more ovate-truncate: the thorax is somewhat orbicular, narrowed at the base, very convex, with a central ridge and two lateral tubercles, the spaces between them clothed with long yellowish hairs; scutellum very minute; elytra oval, more globose in the female, with lines of punctures and series of yellowish hairs; the legs are of moderate size and pubescent; the thighs clavate; shanks rather long and slender; feet longish, five-jointed, basal joint the longest, fourth the smallest; claws small.†

* Dissections of the mouth, and more ample characters, will be found in Curtis's *British Entomology*, fol. and Plate 510.

† Mons. Audouin discovered in the granaries at Versailles the little beetle *Ptinus fur*, with its larva in great abundance, and he clearly ascertained that they fed on the flour and damaged it to a great extent.—*Annales de la Soc. Ent. de France*, vol. v. p. lxii.

ULOMA CORNUTA—*the Horned Maize-beetle.**

I ought not to omit mentioning a beetle which not only inhabits maize, in the spikes of which it has been found alive in this country, but I have frequently taken it out of bread in London. It is a native of Portugal, and no doubt is imported with the corn. This coleopterous insect belongs to the family TENEBRIONIDÆ and the genus ULOMA: the species has been described by Fabricius† as the—

12. *Uloma cornuta.*—It is tawny ferruginous, smooth, shining, and very finely punctured, elliptical, and slightly depressed. The male has a broad head, the sides of the clypeus are dilated and form a winged margin, which passes across the centre of the black eyes; between them is a pair of tubercles, and in front project the two curved pointed jaws: in the female the jaws are small, and the margin of the clypeus is simply dilated: antennæ inserted under the clypeus not so long as the thorax, straight, slightly thickening to the apex, eleven-jointed, basal joint curved, second the smallest, the following more or less cup-shaped, the terminal one orbicular: thorax transverse-quadrate, the sides a little convex, the hinder angles acute: scutellum minute, semi-ovate: elytra not broader than the thorax, but long and elliptical, the margin a little reflexed, minutely punctured, with ten punctured striæ on each, the first short: legs simple, tarsi five-jointed excepting the hinder pair, which are only four-jointed: claws two: length, $1\frac{3}{4}$ line; breadth, $\frac{2}{3}$ line.‡

TROGOSITA MAURITANICA—*the Cadelle.*

The history of this beetle will complete my observations upon the insects which infest granaries and barns. It has evidently been introduced from the shores of Africa, in which country it is abundant, as well as in America, and has now spread itself over a great part of Europe, so that it is common in the south of France in the larva state, and makes very great havoc amongst the corn locked up in granaries; it also attacks dead trees, and even bread and nuts. No doubt the specimens found in this country of the *T. mauritanica* have been imported amongst fruits or grain, but it is clear that they colonize occasionally, from the fact that Mr. C. C. Babington found them in the rotten floor of a malt-house in Cambridge. Mr. Kirkup also bred the beetle from a Spanish almond, in which it lived as a larva for fifteen months, after which it remained alive as a beetle for twenty-one months, making a period of three years, besides the time it had been in existence previous to its being discovered in the almond.§

* *Myrmidius ferrugineus*, Leach, is, I believe, the female.

† *Entomologia Systematica*, vol. i. p. 112, No. 13.

‡ For dissections, and the other species, see Curtis's *British Entomology*, fol. and Plate 368.

§ *Transactions of the Entomological Society*, first series, 1812, vol. i. p. 329.

The larvæ are called *Cadelle* in the south of France, and they are particularly destructive, because they eat the outside of the grain, and, passing from one to another, they injure as much or more than they consume. They do the greatest mischief at the end of winter, when they are full grown, and are about 8 lines long and 1 line broad: the body is whitish, composed of twelve segments, distinct enough and rough, with short scattered hairs: the head is hard, scaly, black, and furnished with two curved, sharp, horny jaws: the three thoracic segments of the body bear each a pair of short scaly legs, and a pair of obscure spots; the anal segment is terminated by two very horny hooks: figs. 27; *n*, the natural length. They enter the earth, or bury themselves in dust, to become pupæ, of which I have no description.

The beetle belongs to the family TROGOSITIDÆ and the genus TROGOSITA. Linnæus was well acquainted with this species, which he named—

12. *T. mauritanica*, and it is the *T. caraboides* of Fabricius (figs. 28). It is 4 lines long and 1¾ broad (figs. *o*), depressed and regularly punctured, of a pitchy colour, with a shade of chestnut; the antennæ are rather short, remote, and inserted in a deep cavity before the eyes; they are clavate, slightly pubescent, and eleven-jointed; basal joint stoutish, second minute, third a little oblong, the remainder increasing in diameter, three or four of the terminal ones forming a compressed club, a little produced internally, the apical joint suborbicular; the mouth is furnished with an upper and under lip, two strong bifid jaws, black at their tips and meeting in front, two ciliated maxillæ and palpi, which are subferruginous: head broad, semi-orbicular, hollowed on the crown: eyes small, black, lateral, and not touching the thorax, which is broader than the head, somewhat orbicular, broadest before, rounded at the base, the sides slightly margined, anterior angles produced and incurved, posterior acute; scutellum small, semi-ovate; elytra broader than the thorax, from which they are separated by a narrow neck and nearly thrice as long, elliptical, a little narrowed towards the base, with nine delicately punctured striæ on each, the interstices punctured and transversely scratched; wings moderately ample; six legs short, anterior pair the stoutest; thighs very short and stout; shanks short, compressed, dilated at the apex, especially the anterior, with two minute teeth at the outer and two curved spurs at the inner angle; tarsi as long as the tibiæ and four-jointed, ciliated beneath, first three joints short, fourth long and clavate; claws strong and curved.

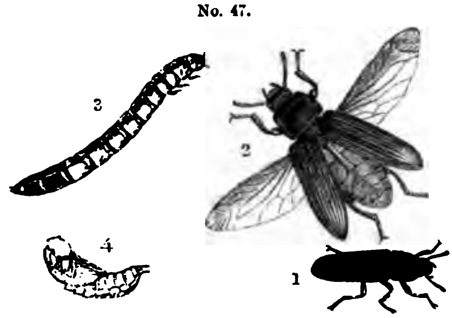
The beetle is carnivorous, and makes some amends for the mischief it had done in its larva state by destroying the *Tinea granella*, and it is not yet known where the female deposits her eggs.*

* It is said also to feed on the receptacle of wheat in granaries.—See *Transactions of the Entomological Society*, vol. iii. p. xx.

There are, however, two beetles which are far from uncommon in flour-mills, flour-stores, and even in the flour-bins of dwelling-houses, which will complete this portion of our subject. The first is named—

13. *Tenebrio molitor*, Linn.—the Meal-worm Beetle.—It generates in flour, bran, and meal bins, and is consequently found in granaries, mills, and farm-houses. The beetles appear in April, May, and June. They are smooth, slightly depressed, and of a pitchy or chestnut colour, especially the under side and legs; minutely and closely punctured; head somewhat orbicular, with two small eyes, and short, slender, eleven-jointed horns: thorax sub-quadrate; hinder angles acute: elytra elliptical, with sixteen shallow furrows, and beneath them ample wings, which are smoky on the costa: legs stout; feet five-jointed, hinder pair with only four joints: No. 47, fig. 1; flying and magnified at 2. The meal-worm is cylindric, smooth, ochreous, with bright rusty bands, and a few scattered hairs; two small horns, six pectoral legs, and two minute spines at the tail (3). The pupa (4) is pale ochreous, with the members visible, and two spines at the tail. The second species is—

No. 47.



14. *T. obscurus*, Fab.—It is similar in form to the foregoing, but the beetle is dull black, the under side, horns, feelers, and feet, chestnut colour, and the thorax is longer. The larva is shining, pale-brown, and prefers dry and sound flour, whilst the other meal-worm thrives best amongst damp and damaged flour. *T. molitor* is an old inhabitant of England, but *T. obscurus* has been introduced with American flour, and is sometimes abundant in London and the provinces. Cleanliness is the best guard against these insects; and the meal-worm is a favourite food of nightingales.

Having now, by descriptions and illustrations, enabled the reader to identify these pests, and, by tracing their histories, exposed their vulnerable points, it is for those who have the opportunity to follow up the inquiry, and to supply those deficiencies in the economy of the insects which are wanting to complete the account of their metamorphoses; and we recommend the parties interested in these investigations to practise those remedies best suited to each case, and, above all, to communicate the result to men of science as well as to the public.

There are so many interests concerned in this portion of our subject, that no one could be indifferent to the transformations of these noxious insects, if it were not that an immense proportion of the public is ill informed, or totally ignorant of the silent but powerful operations of nature. There is still one important topic which I have not yet alluded to, but which is deserving of attention. In looking back to the variety of insects that feed upon the corn in granaries, and the multitudes that are often congregated in one heap, there can be no doubt that a very large portion of them must be occasionally ground up with the corn and consumed by the public. This is not only a disagreeable fact, but it may be the source of very serious consequences, for I think it not improbable that many diseases might be traced to the insects which are converted with the infested flour into bread, amounting to such a large percentage, that if they have the slightest medicinal or deleterious qualities, it is impossible to deny the influence they must exercise upon the human system.* I have known bushels of cocoa-nuts, which were every one worm-eaten and full of maggots, with their webs, excrement, cast-off skins, pupæ and cocoons, all ground down to make chocolate, flavoured, I suppose, with vanilla!

SUMMARY OF THE FOREGOING CHAPTER.

Scopula frumentalis inhabits *wheat fields* in June; the caterpillar is injurious to the crop.

Pyralis secalis. The caterpillar lives in stems of *rye*, rendering the ears white and empty.

Caterpillars of *Apamea I-niger* in *wheat plants* in March.

A hymenopterous *parasitic fly* infests these *larvæ.*

The *caterpillar* of a moth, *Leucania obsoleta,* will eat the leaves of the *oats.*

They only come out at *night to feed.*

The *slug-like larvæ* of a beetle, *Crioceris melanopa,* feed upon the oat leaves in June.

The *caterpillar* of a full-bodied moth feeding on the corn in a barn.

They *disliked the light,* and buried themselves amongst the corn.

They *spun* fine but *slight cocoons,* attaching grains and chaff outside, previous to becoming chrysalides.

Numerous grain-feeding *insects imported* with corn.

Cleanliness in granaries an important object in checking their ravages.

Noxious insects much more abundant in the south of France, Italy, &c., owing to the *high temperature.*

This has led to the *cultivation* of *Entomology* generally abroad.

* A medical man in Madeira assured Mr. Mills "that he considered the wings and the crustaceous parts of the weevil so heating to the system as to be almost as injurious as *Cantharides*, taken internally, on a slow scale."—*Transactions of the Entomological Society,* vol. i. p. 242.

Laws passed for the destruction of insects, and distinguished men engaged by the governments to investigate the causes of the failure of crops.

Our *cold climate destroys* many imported *insects;* whilst others, more hardy, *become naturalized.*

Insects appear to *progress* from the south-east to the west or north, and often disappear suddenly.

The little corn-moth, *Butalis cerealella,* commits dreadful ravages in France, entailing *famine* and *epidemics.*

It is gradually *spreading itself* in Central France, and seems to have reached the United States.

The infested corn *loses* 40 *per cent.* in weight, and 75 *per cent.* of flour.

The *caterpillars* live in the *grain* of wheat, barley, oats, and maize.

The moth deposits *twenty or thirty eggs* upon the *grain* in the *field* as well as in the *granary.*

They *hatch* in *six or seven* days, sometimes in *four days.*

The little *caterpillar eats* into the *grain,* only one occupying each kernel.

When the flour is all consumed it *changes* to a *pupa* inside the *husk,* which it lines with a silken *web.*

The *grains* at this time *appear* perfectly *sound* to the eye, but are *soft* to the touch.

They seem to *devour* their own *excrement* once or twice.

The end of *November* there are many *caterpillars* in the *grain;* in the *spring* mostly *pupæ.*

Some of the *eggs* hatch much earlier than others.

The *moths* appear in the beginning of *May* or in *June,* and again in *November.*

They make their way out of the grain through a little hole cut by the caterpillar, and *live* only *two or three weeks.*

A parasitic fly, amounting to twenty, is sometimes hatched from one pupa.

The *moths* hatched in *May* escape by the *windows,* those that are born after *harvest* remain in the *granaries.*

The *caterpillars* and *chrysalides* may be *killed* by applying *heat,* and its moderate action for a certain period is more efficacious than intensity for a short time.

An *insect-mill,* like a coffee-roaster, at a temperature of about 167° *of Fahrenheit,* will deprive the beetles of *life* in the *grain.*

Corn submitted to this heat is not more subject to *ferment,* to be *devoured* by insects, nor is it less capable of *vegetating,* than that which has not undergone the operation.

The *expenses* attending it do not amount to *three farthings per bushel.*

Another machine for *shaking* the grain is expected to destroy the insect in its different stages.

The *wolf*, or little grain-moth, is abundant in our *granaries* from *April* till *August.*

The *caterpillar* does incredible mischief to *bonded corn*, feeding on wheat, barley, rye, and oats, and it is said also on old timber, books, boxes, woollen stuffs, &c.

The female *moth* lays about *thirty eggs*, depositing one or two on each grain.

The *caterpillars* hatch in *sixteen days* or less, and penetrate the grain, eventually uniting several together by a web.

They sometimes *cover* the whole mass of *corn* with a *web* three inches thick.

In *August* or *September* they are *full grown*, and leave the corn-heaps, and change to chrysalides in a web in the floor, walls, or roof, and will even eat into the knots of fir saturated with turpentine.

They live there as *larvæ* until *March*, or even *May*, when they are transformed to *chrysalides.*

The moth deposits its *eggs* on the *sheaves* in the *field*, as well as on the *corn* that is *housed.*

Before *filling* an empty *granary*, *cleanse*, scour, and white-wash it thoroughly, in the *winter* if possible.

Other remedies, by the application of *heat* or *cold*, should be tried in *summer*, when the larvæ are at work.

The *moths* may be *destroyed* in the spring by *burning lamps* or *gas-lights*, at the same season *turn over* the corn to *destroy* the *eggs* and disturb the young *caterpillars.*

Plaster the *walls smooth* inside, filling up all cracks, &c. *Stop* all *apertures*, covering those for ventilation with wire-gauze.

Kiln-drying at about 78° Fah. will *kill* the *larvæ* when they are feeding.

The *caterpillars* cannot bear a lower temperature than 55° Fah.; they became torpid at about 46°, and soon *die.*

Cold currents of air, introduced by small windows near the floor, is a sure remedy.

Burning sulphur, and creating sulphuric acid, will *kill* the *moths* in a close apartment.

Corn has thus been kept by the party recommending this mode for six years.

It is feared the *caterpillars* will *escape* the fumigation by burying themselves in the corn-heaps.

Scattering salt over the corn is beneficial, and if powdered and mixed with the corn will *kill* the *caterpillars;* or it may be dissolved in water and sprinkled over the heaps.

A small *heap of corn* left *undisturbed,* frequently turning over the rest, is a sure and simple plan of *catching* the *larvæ,* and they can easily be destroyed by pouring boiling water over.

Diseased corn should be *sown deep,* to prevent the moths escaping from the chrysalides.

If *corn* be left long standing in the *field,* the moths soon deposit their *eggs* in the *ears.*

Bats, spiders, and *small birds* are the natural *enemies* of the grain-moth.

The *rice-weevil* is found amongst rice, and in *wheat* imported from Italy, in *granaries,* and in *ships.*

The *maggot* lives in the grain and *feeds* on the *flour.*

The *grains appear sound* outside, with a minute hole towards the bottom.

About *ninety-five per cent.* of the *flour* destroyed in a sample from Ancona.

The *pupæ* are similar to those of other weevils.

An *apterous parasitic insect,* one of the *Diplolepidæ,* preys upon them.

The *granary-weevil* bores a hole in the grain of wheat, and deposits an *egg* in it.

The *maggot* lives in the *grain,* changes to a *pupa* there, and in *eight or ten days* the *weevil* eats its way through the skin.

Only *one maggot* lives in *each grain,* and it is in this state they do so much mischief, although the *weevils* are believed to feed upon the *corn also.*

If the temperature be kept under 50° *Fah. the sexes do not pair,* and they do no further mischief.

When it is *cold* the *weevils* become *torpid.*

In *April they pair,* if the temperature be 54°, and they go on *propagating* until the end of *August.*

The *warmer* the *weather* the more *eggs* are deposited, but the females *cease to lay* when it becomes *cold.*

So fast do they *multiply* in the south of France, that sometimes in a *corn-heap* nothing but the *husks* are *left.*

It does not take more than *six weeks* to undergo all the *changes,* from the laying of the egg to the hatching of the weevil.

It is calculated that 6045 individuals may be reared from *one pair* of *weevils* in a *summer.*

As soon as the *female* is *impregnated*, she *buries* herself in the corn-heap to lay her eggs.

The presence of these *insects* in the grain *cannot be detected* by looking at a corn-heap, but on throwing the *grains* into water they *float*.

As long as the *weather* remains *hot*, the *weevils* keep in the *corn-heaps*.

When the *mornings* become *cool* they leave them, and *secrete themselves* in crevices and chinks in the walls, wood, &c.

The *weevils* do not like *light*, and bury themselves if possible when exposed to it.

The *granary-weevils* are never found in the *fields* in *England*, and consequently the *eggs* are only laid when the *corn* is *housed*.

The *granary-weevil* can bear our *climate* much better than the rice-weevil.

In the East and West Indies *Calandra oryzæ* is exceedingly abundant in the *magazines*.

They expose the *grain* to the sun, and *winnow* it frequently.

Barley and *malt* suffer most from the *Calandra granaria*. On placing the *beetles* in a box with *barley*, *maize*, wheat, pease, and beans, they only attacked the two first; but in other instances *wheat* and *black oats* were devoured.

In mild seasons the *granary-weevil* may be found *all the year* in warm granaries and mills, and in *sultry weather* on the *outsides* of the *buildings*.

Fumigating with strong-scented *herbs* only communicates a disagreeable *odour* to the *grain*, as the weevils escape by burying themselves in the corn.

The scent of *spirits of turpentine* did not appear to incommode the weevils, but it would, if persevered in, at the same time excluding the atmospheric air.

The *fumes* of *sulphur* failed from the same cause, and still less affect the larvæ contained in the grain.

Placing the corn in *close cellars* the worst of all proceedings, as the *weevils* delight in *darkness* and being *undisturbed*.

Sifting in the *winter* useless, as the *weevils* are *not* then in the *corn-heaps*.

A sudden heat of 75° Fah. will *destroy* the *weevils*, but it will not suffocate them when buried in the corn-heaps.

The *eggs* and *larvæ*, as well as the weevils, are destroyed by 190° *Fah.*, but it also scorches the corn.

In *Madeira* the *eggs* are believed to be laid in the *flowers* of the *maize*.

The *eggs* are *hatched* at 110° Fah., whilst 130° to 140° *killed* them.

A room heated to 135° by hot *water-pipes* has been constructed in Madeira, which answers every purpose.

The *wheat* subjected to this high temperature *vegetated* in the ground.

In Norfolk the *windows* of an empty granary are *set open* for two or three nights during a *frost*, which expels the weevils.

Fleeces of wool laid on the corn-heaps *attract* and *kill* the *weevils.*

In London the *malt* does not suffer from these pests, when *white-washing* the granaries and frequently *stirring* or turning over the heaps are *regularly attended to.*

A little beetle called *Silvanus surinamensis*, with its larvæ and pupæ, sometimes abound in *granaries.*

It inhabits *bran* also, and is found under the *bark of trees.*

A smaller beetle, called *Cucujus testaceus*, has been found in great abundance in *granaries* and *mills.* It has also been detected under the *bark* of elm trees in *December.*

Inhabited the *wheat* from *Ancona* with its larva.

Another species, the *Cucujus minutus*, infests the *maize.*

Ptinus crenatus often accompanies them, *eating* into the floors and *wood-work.*

Kyanizing the timber used, the best remedy against their inroads.

Uloma cornuta is a beetle which inhabits the *maize-spikes*, and is often found in *London bread.*

The *Cadelle* is the larva of a beetle which is mischievous in *granaries*, especially in the south of France.

It inhabits also *dead trees*, and will attack *bread* and *dried fruit.*

It has been *imported*, and a colony of them was found in the floor of a *malt-house* in Cambridge.

It was bred from a *Spanish almond*, in which it *lived* as a larva and beetle for *three years.*

The *Cadelle* eats the *outside* of the *grain*, injuring more than it consumes.

These *larvæ* are most troublesome at the *end of winter*, and become *pupæ* in the *earth* or amongst dust.

The beetle is called *Trogosita mauritanica*, and devours the *Tinea granella.*

The *meal-worm*, *Tenebrio molitor*, breeds amongst damp and damaged flour.

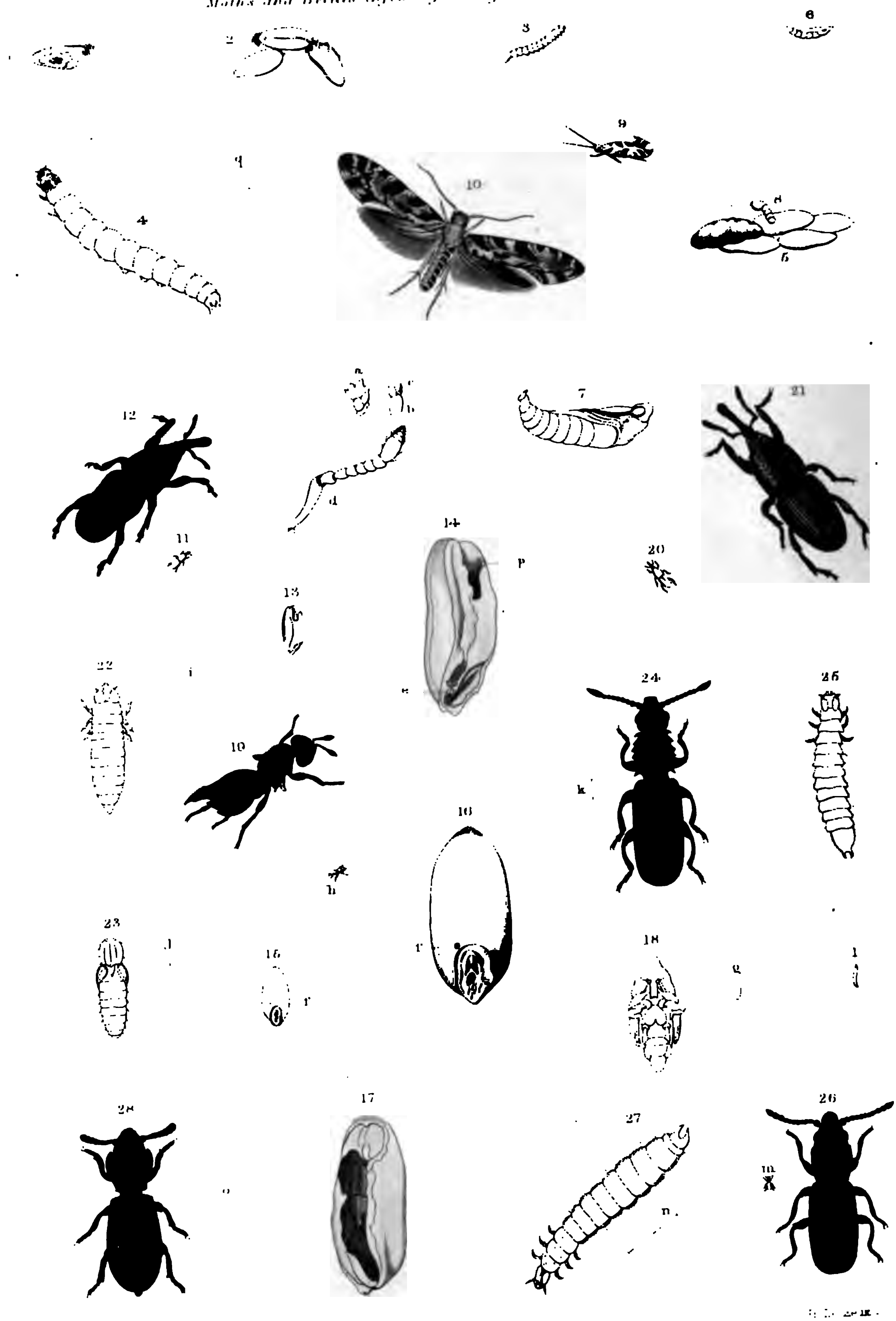
T. obscurus prefers dry and sound flour. Sometimes abundant in London and the provinces.

These *insects* ground up with our *food*, in all probability *injurious* to the *constitution.*

Chocolate sometimes manufactured from *cocoa-nuts* swarming with *insects.*

CORN-FIELDS AND GRANARIES.

Moths and Beetles infesting Corn-fields and Granaries



EXPLANATION OF PLATE K.

Fig. 1. A grain of wheat opened, to show the cavity in which the caterpillar of *Tinea granella* had fed, with the excrement at the apex.
Fig. 2. Several grains united by the same caterpillar.
Fig. 3. The caterpillar of *Tinea granella*.
Fig. 4.* The same magnified.
Fig. 5. A group of the cocoons spun by the same.
Fig. 6. The *chrysalis* taken out of a cocoon.
Fig. 7.* The same magnified.
Fig. 8. A *chrysalis* sticking in a cocoon after the moth was hatched.
Fig. 9. *Tinea granella* at rest.
Fig. 10.* The same flying, and magnified.
q, The natural dimensions.
Fig. 11. *Calandra oryzæ*, the rice-weevil.
Fig. 12.* The same magnified.
*a**, One of the mandibles or jaws.
*b**, The maxilla.
*c**, The palpus or feeler.
*d**, The antenna, or horn.
Fig. 13. A grain of wheat opened, to show the burrows of two beetles.
Fig. 14.* The same magnified.
e, The maggot of *Calandra oryzæ*.
p, The burrow of *Cucujus testaceus*.
Fig. 15. A grain of wheat.
f, The hole eaten by the *larva* of *Calandra oryzæ*.
Fig. 16.* The same grain magnified.
f, The hole perforated by the little maggot.
Fig. 17.* The grain of wheat opened to show the perfect weevil inside.
Fig. 18.* The *pupa* of *Calandra oryzæ*.
g, The natural size.
Fig. 19.* The parasitic fly, *Meraporus graminicola*.
h, The natural size.
Fig. 20. *Calandra granaria*, the granary-weevil.
Fig. 21.* The same magnified.
Fig. 22.* *Larva* of *Silvanus surinamensis*.
i, The natural length.
Fig. 23.* *Pupa* of the same.
j, The natural length.
Fig. 24.* *Silvanus surinamensis*.
k, The natural length.
Fig. 25.* *Larva* of *Cucujus testaceus*.
l, The natural dimensions.
Fig. 26.* *Cucujus testaceus*.
m, The natural size.
Fig. 27.* *Cadelle*, or *larva* of *Trogosita mauritanica*.
n, The natural length.
Fig. 28.* *Trogosita mauritanica*.
o, The natural length.

Those numbers and letters with a * attached, refer to the objects which are represented larger than life. All the figures are drawn from nature, excepting Nos. 3, 4, 5, 6, 7, and 8, which are copied from Roësel, and 22, 23, and 27, from Westwood's *Modern Classification*.

CHAPTER XII.

THE NATURAL HISTORY AND ECONOMY OF THE INSECTS AFFECTING THE PEASE AND BEANS, INCLUDING WEEVILS, MAGGOTS, BEES, PLANT-LICE, GRAIN-BEETLES, MOTHS, AND THE MOLE-CRICKET.

MILLIPEDES.

PEASE are subject to many casualties, arising from atmospheric changes and the attacks of insects. A similar mildew to that which affects turnips and rose-leaves often renders the crops very sickly, and then they fall an easy sacrifice to the insect tribes. If the season be cold and wet when early pease are committed to the earth, they frequently are infested by the millipedes,* which eat into the softened and decomposing seeds; and even if they have sprouted, few of them are able to struggle through the soil when thus weakened, and the winter and early sown crops are consequently lost to the grower.

PEA AND BEAN WEEVILS.

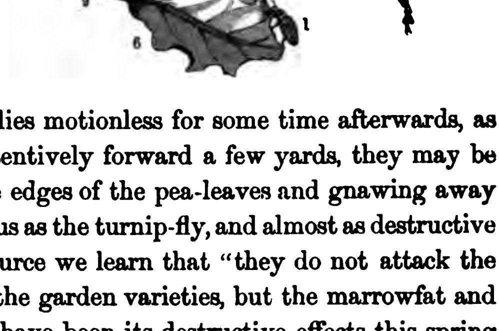
The next enemy these crops have to encounter are small beetles called weevils, which either destroy the plants as fast as they push above the surface, or nibble the leaves and notch the edges when they have expanded. Most farmers are very imperfectly acquainted with the economy of these insects, and it was a long time before gardeners could be convinced that it was a weevil which caused them so much anxiety. Some very naturally accused the sparrows; traps were set for rats and mice; lime strewed for slugs and snails; and toads were encouraged to extirpate the wood-lice; but still the crops kept disappearing, as none of these precautions affected the wary enemy in his coat of mail. There were, however, both gardeners and farmers (uniting a close attention to the operations of nature with steady perseverance), who eventually succeeded in detecting the real cause of the mischief.

In favourable seasons the weevils make their appearance at the end of March, but April is the month when they are most destructive to the pea-

* *Iulus pulchellus* and *Polydesmus complanatus*, chap. vii.

crops, and one then finds that healthy shoots are daily, if not hourly, disappearing in a most marvellous manner, without any apparent cause, so that spaces of a foot in length, and sometimes the entire rows, are lost, or the few that may be left are so weak that the produce can be reckoned of little value. The year 1844, if I may judge from the number of communications transmitted to me, appeared to be well suited to these weevils, which were actively at work in thousands in the vicinity of Hertford at the end of March, continuing their operations for a fortnight, and entirely eating off the second and third sowing when the plants had grown from two to four inches high. At this period of the year they issued from the ground from nine to ten o'clock in the morning, to feed all day upon the pease; and they retired under the clods of earth on the approach of evening. They were equally troublesome at Stafford the first week in April, when they ate off the early pease; and in the Isle of Wight these weevils were not less destructive, for there they attacked the beans as well. On the 30th of the same month I received from Mr. Pusey an interesting account of this beetle, communicated by Mr. Robert Baker, stating that some garden marrowfat-pease were drilled early in February, which were retarded in growth from the cold north-east winds and wet, and destroyed by the ravages of this insect, which notched all the leaves (Plate L, and No. 48, figs. 6), and in many instances entirely defoliated the stem: fig. 7. It most abounded on light turnip-soil. Mr. Baker correctly observes that "it is exactly the colour of the soil, and very difficult to detect, as upon the approach of any one it falls down suddenly from the pea, and lies motionless for some time afterwards, as if dead; but if any one looks attentively forward a few yards, they may be observed in scores sitting upon the edges of the pea-leaves and gnawing away earnestly, with appetites as voracious as the turnip-fly, and almost as destructive in the result." From the same source we learn that "they do not attack the common hog-pea so vigorously as the garden varieties, but the marrowfat and early pease suffer most; and such have been its destructive effects this spring that nearly all my garden crops are destroyed by it." This was corroborated by the fact that the maple-gray pease nearly escaped, whilst the remainder of eight acres in the same field were obliged to be ploughed up. What has occurred at Hertford since Mr. Webb wrote to me I have not been informed;

No. 48.



but at the beginning of May in the following year, the weevils were committing dreadful havoc with crops of pease and beans in the neighbourhood of Ware.

It is somewhat remarkable that this beetle, named *Curculio lineatus*, commences with the pease in March; then it affects the broad beans to such an extent, that I have not been able to find a single leaf in a field of many acres which has not been notched as much as the one represented in the plate (fig. 8); and in August, and until the close of the autumn, its ravages are transferred to the crops of clover and lucern. On the 18th of that month, 1843, I received a communication from Mr. C. Parsons, of North Shoebury-hall, Essex, which is too valuable to be passed over. He says, "I inclose you a beetle, very destructive in these parts to the young plants of clover, lucern, &c.; so much so, as often totally to destroy whole fields, and especially those of lucern (*Medicago sativa*), which they attack in such a way that for several years past no one has been able to obtain a full plant, although going to the expense of sowing the land two or three times over. The damage is attributed by our farmers here to the turnip-fly, and the habits of these little weevils render it in the spring of the year exceedingly difficult to detect, as the moment one approaches near, down they fall upon their backs amongst the clods, and remain motionless with their legs folded up. I have searched a long time in vain for them in fields where they were committing their ravages, in order to convince my neighbours what they were indebted to for the loss of their crops. At this time of the year they are readily enough obtained, as the pease, beans, and other papilionaceous plants often swarm with them. I have a field of pease that does so at this time, the remaining leaves of which they have completely riddled; and when a person walks in amongst them you may hear a pattering like rain upon the leaves, occasioned by their dropping down. I last year sowed a small piece of lucern in July, that was untouched by them; now, whether at that time they are absent, or whether there is any interval between a first and second brood of them, would be very desirable to know, as we might then perhaps steal a march upon them."

Two years previous to this, namely, the 15th of September, 1841, Mr. William Trenchard transmitted me the following instructive observations from Marsh Farm, near Sherborne, Dorsetshire, which carry forward the economy of the weevils several weeks later:—"Walking along the headland of a field of broad-clover, from whence the barley had been carried about a fortnight, I was surprised to see that throughout, for the width of four or five yards from the hedge, the plant was very much injured, and in many parts quite destroyed, from having been bitten apparently by some insect. Nearly every leaf was eaten round the edges, and so deeply were they indented, that those parts of the leaf not eaten are withered from the sap not being able to ascend. Curious to know by what animal such ravages could have been made (for I suppose the headland is more than half an acre), I examined the clover to discover the depredator, but for a long time unsuccessfully, until at length having stood quite still and watched the leaves intently for a considerable time, I ascertained that it was done by a number of small brown beetles, which immediately, on moving near, hid themselves by getting under the leaves, and on a nearer approach they let go their hold altogether, and fell to the ground as if dead, but immediately recovered and crept among the roots of the clover, where they remained until all was again quiet. Being so exceedingly shy, it was a long time before I could see any of them actually eating, but by perseverance I eventually succeeded in observing several. They attack the edge of the leaf, holding it steady between their legs, whilst they eat down from top to bottom like a silkworm. To give some idea of their numbers, when I moved the clover with my hand or foot, they fell off by dozens." On the 14th of October, Mr. Trenchard again wrote to say that since his last communication "the beetles have considerably extended their depredations in the field alluded to; but I do not see they have done any injury in the other fields, though in every one of broad-clover there are many leaves bitten, apparently by slugs, but I have no doubt really by these insects."

It still remains to be ascertained where the eggs are deposited. This operation must take place, one would imagine, in the summer or autumn, unless the weevils hibernate, as they are ready to take the field in the early spring, and in April they abound on the broom and furze in Norfolk, Surrey, &c. It is equally remarkable that we are ignorant where the larvæ feed; but my friend Mr. Spence has informed me that, owing to the crops of beans in Yorkshire suffering from galls found upon the roots, there is some reason to believe that they are the nidus of the larvæ of *Curculio lineatus*, or an allied species. I have, however, examined the bean-roots where the weevils are abundant in this country, without discovering any of the galls; yet I hope this notice may lead to a more extended examination than I have been able at present to make, relative to such an important point; for until we are in possession of the early economy of the insect, it is to a certain extent hopeless to look for a remedy.

These beetles, or weevils, are of the order COLEOPTERA, belonging to the family CURCULIONIDÆ, which embraces some of the greatest enemies the gardener, farmer, and maltster have to deal with.* The species before us

* See chapter xi.

was called by Linnæus CURCULIO, but is now comprised, with about twenty others inhabiting this country,* in the genus SITONA, and has been described as—

1. *Sitona lineata*, Linnæus—the Striped Pea-weevil (Plate L, fig. 1; fig. 2, the same magnified; and No. 48, fig. 1, the *female;* fig. 2, the same magnified).—It is more or less of an ochreous or light clay colour, elliptical in form and convex above, punctured and clothed with minute scales, and when these are worn off by age or accident, the beetle has a black shining surface; the head (fig. 3, in profile) is deeply punctured, the scales in some lights having a bright coppery tint; it is elongated; the face is concave, with a channel down the centre, and forms a short stout nose, which is notched, and at the extremity the mouth is placed; this comprises five pieces, two strong black mandibles for biting, notched on the inside (fig. 4, *b*); two maxillæ below them, the inside ciliated with spiny bristles, the outside producing each a short stout feeler composed of three joints, the two first subquadrate, the last oval (fig. *c*); between the maxillæ is placed the chin (fig. *d*), which is tridentate with two smaller triarticulate feelers, the basal joint is very stout, the second semiovate, the third short and very slender; the eyes are lateral, prominent, orbicular, and black: below them on each side is a deep angular groove to receive the two antennæ or horns, which are inserted towards the tip of the nose; they are of a tawny colour, brownish at the extremity, which forms a spindle-shaped club; they are twelve-jointed, the first joint very long, clavate, and forming an elbow with the remainder, second longer than any of the following, the succeeding six decreasing in length from pear-shaped to oval, the remainder forming a four-jointed club; the apical joint minute (fig. 3, *a*): the thorax is deeply punctured, broader than the head towards the base, the sides being convex, and three ochreous lines are formed by the scales down the back; the scutel is minute and whitish; the wing-cases are broader than the thorax, elliptical, rounded at the apex, finely punctured, with ten punctured striæ forming stripes, alternately of a light and darker clay tint: the two wings are very ample, and folded beneath the elytra: the six legs are ferruginous, short and stoutish (fig. 5); the thighs are thickened, but contracted at their tips, and black at the middle; the shanks are narrowed at the base; the tarsi, or feet, are four-jointed, basal joint pear-shaped, second obtrigonate, third bilobed, all cushioned beneath except the fourth, which is long, clavate, and terminated by two small claws. These weevils vary greatly in size and colour, some showing the stripes distinctly, whilst in others they are scarcely visible, and in old worn specimens they are more or less black and shining.

* Curtis's *Guide to an Arrangement of British Insects*, second edition, Genus 375.

Another species of the same genus often participates in the ravages exhibited by the pease. It is upwards of forty years since I saw in Norfolk a bed of pease eaten off by this weevil, called *Curculio* or *Sitona crinita*. A correspondent of the *Gardener's Magazine** also thus records its depredations:—"They appeared in great numbers with the warm weather at the end of March, 1830, on some rows of pease about two inches high. The pease are now only fit to be dug in. They feed only by day, when the sun is bright, five or six of them being on each plant. When I go near the row, they fold themselves up and drop down, some on the ground and some in the axils of the leaves, where they lie for the space of a minute, appearing like small bits of earth. I have never seen them fly, but they run very quick. I have upwards of 300 feet of row, the greater part of which is worse than the specimen sent, and none better."†

2. *Sitona crinita* of Olivier, the Spotted Pea-weevil, is identical with the *Curculio macularis* of Marsham: figs. 9; figs. 10, the same highly magnified.—This insect is generally smaller than *S. lineata*, but it so exactly resembles it in form that I need only describe its colour. It is black and shining, clothed with grayish or rosy-coloured scales and short hairs; there is a pale line over each eye, and four dark stripes on the thorax, leaving a pale dorsal and two lateral stripes: the elytra are rather rough, with short bristles behind; the interstices formed by the ten lines of punctures are more or less spotted irregularly with black; the horns and legs are the same colour as in the other species.

From the imperfect and slender data relating to insects connected with agriculture, it is frequently difficult, if not impossible, to form any opinion as to the simultaneous or periodical appearance of the different species; and with regard to these weevils, all that can be stated is, that certain seasons seem to favour their multiplication, and others to check it. It is evident that if not checked, there is not a crop, whether in the field or garden, that would escape destruction; and this check, probably in every instance, might be traced to the agency of other insects, especially parasitic species, which I have so often shown are destined to the service of man. I have already alluded to the universal spread of these weevils in 1844; I well remember that in April and May I could not find a pea-field where the lower leaves of some plants were not eroded, the beans were equally marked; and Mr. Webb‡ in his letter said, "it is not only incredible that this little beetle should be capable of doing so much mischief, but it is singular that for the seven pre-

* Vol. vi. p. 615. † Communicated by Mr. W. P. Vaughan, Archdeaconry, Brecon.

‡ See page 343.

vious years I had never failed in producing crops of pease in the garden of Sir William Horne."

Ignorant as we are of the early stages of these weevils, the only remedies we can at present apply will be in destroying or annoying them in their beetle state, and from their horny shells and power of contracting and protecting their members, it is difficult to find any application that will extirpate them without injuring the plant. For the garden, I should recommend the tarring or painting two strips of canvas, and placing one on each side of a row of pease early in the morning, and two or three hours after, by shaking the plants, the weevils would fall down and be held fast by the adhesive surface. This might be repeated several times each day, until it would be seen that their numbers were sufficiently reduced to secure the crop. Of course the painting or tarring must be repeated whenever it is too dry to fix the objects falling down.

Neither soot, wood-ashes, nor lime will injure the weevils, we are informed, and can readily believe; yet by dusting over the pease early in the morning with any or all of these powders, whilst the leaves are damp, their food will be rendered so unpalatable that the enemy will be driven to forage elsewhere; and if a row of pease were sown near, which was left undusted, the beetles would resort thither, and when it was clear (by the erosion of the leaves) that the plague was congregated there, boiling water poured along the line would eradicate them, and thus the principal sowing might be saved; or the tarred canvas might be most efficiently employed, if that plan were preferred. Mr. Baker has found harrowing or hoeing beneficial when a field of pease is attacked by the weevils. It should be done whilst the dew is upon them, that the earth may adhere and make the plants unpalatable; and he says he has found this one of the most successful modes of checking the ravages of the turnip-fly.

Maggots of Flies in Pea-leaves.

When the plants have attained a good growth, one sees on the leaves little faded patches, with a minute brown speck in the centre (fig. 11, *e, f*); on examining these spots with a glass, it is at once clear that they are the little brown pupæ of a fly, the same as those which infested the turnip-leaves, the larvæ feeding on the parenchyma or pulp. As they have been already described in this volume under the name of *Phytomyza nigricornis*, I need only refer to Chapter iii. for their history.

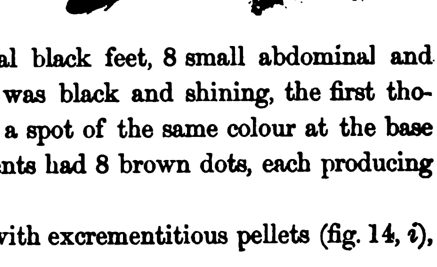
Maggots of a Moth in Pease.

When the pease have escaped the enemies we have described, or survived their attacks, they are not safe from the inroads of other insects. In wet seasons, as in 1845, the pods became diseased and thickened in August (fig. 12), and on opening them I found only one or two abortive peas (fig. *g*), with numbers of little white maggots adhering to the inner surface: fig. *h*. When magnified these larvæ are found to be composed of 13 segments, including the head, which is small (fig. 13).*

This, however, is a casualty probably of rare occurrence, and altogether escaped in fine seasons; but there is another maggot which never fails to annoy the grower of this valuable vegetable. Disease is not required to engender these caterpillars, for the fuller and healthier the pods, the more likely are they to contain the insect we allude to. If our surprise has been naturally excited at the little that is known of the transformations of the pea-weevils, how much more extraordinary is it that no author, that I am aware of, has even ventured to hint at the name of the parent of these disgusting maggots, which are amongst the oldest enemies to the crop, sparing neither field nor garden pease, and annually making their appearance. I have frequently tried to rear them, but with no success; the nearest approach was made by a friend, who found one had spun a silken web of the finest texture, between a piece of paper in a chip box, but the caterpillar then died.

Worm-eaten green pease are no doubt familiar to every housekeeper as well as to the cultivator, for who has not observed that when that excellent pulse is getting old or going off, numbers of the peas are infested by maggots in the pods. There is a cavity in the pea (Plate L, and No. 49, figs. 14) which has been eaten by a caterpillar (figs. 15), who, if not present at the time, generally leaves ample evidence of the meal he has made: figs. *i*.

No. 49.



These larvæ vary somewhat in colour; those I examined in July, 1841, were fleshy and yellow, sparingly clothed with hairs; they had 6 pectoral black feet, 8 small abdominal and 2 anal ones scarcely visible; the head was black and shining, the first thoracic segment had a brown band with a spot of the same colour at the base of the leg; most of the following segments had 8 brown dots, each producing a fine hair: figs. 16, greatly magnified.

The cavities in the pods were filled with excrementitious pellets (fig. 14, *i*),

* The end of July, 1848, the pease in many pods were covered with a dark mould, and thirty or forty little maggots in them; and a few days later, the long pod beans were sooty inside in patches, with several of the same larvæ dispersed round them; no doubt they were the offspring of some two-winged fly.

and the pease were full ripe, indeed those in some pods were changing colour and hard. Only one maggot was found in each, and later in July others from the pease buried themselves the instant they were put upon some earth; the head and thoracic segment of these were brown, not black, and they were stouter than the earlier ones—it is therefore probable that they had changed their skins; and at the same time I observed one from another sample of a more slender form, which had the head and thorax intensely black. In August some pease, although not old, were very much eaten; a portion of the maggots had black, but most of them brown heads. I put these into a breeding-cage, and others into a garden-pot in which a pea was growing, and tied infested pods to the plant, but this plan failed also. During the year 1846 I did not meet with any pease thus affected, to repeat my experiments; but I hope it will not be long before this interesting inquiry is satisfactorily answered. There can be no doubt that the author of the mischief is a moth, which deposits its eggs about May, I expect, either in the flowers or upon the young pod. Some persons have erroneously supposed they were the offspring of the weevils, and many more of a beetle called *Bruchus*, which infests ripe pease, and of which we shall have occasion to speak shortly.

Mr. H. Doubleday and Mr. Guénée having since succeeded in tracing the pea maggot through its different metamorphoses, I am enabled to state positively that a moth has been reared from them which belongs to the family *Tortricidæ*, and is well known under the names of

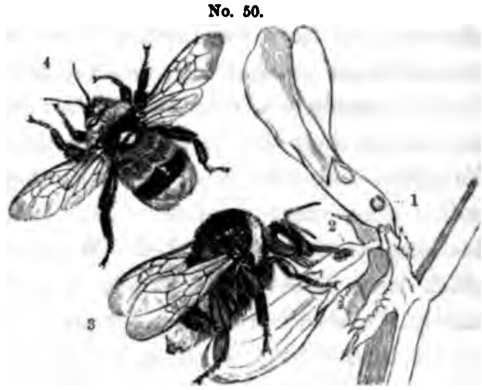
3.—Grapholitha Pisana—*Guénée.*

I suspect that it is identical with the *Tortrix nigricana* of Haworth and the *T. nebutana* of Hübner. The caterpillars spin a fine cocoon in the earth, within which they change to pupæ in the spring, and the moths hatch in June; they expand 7 lines, are mouse-coloured, and satiny; the upper wings lie over the back, covering the under ones in repose: fig. 17; there are several short white streaks on the pinion edge, except at the base, and a silvery oval ring near the posterior margin, within which are five short black longitudinal lines: fig. 18, flying and magnified.

Humble-bees.

It is a well-established fact that bees are exceedingly serviceable in rendering flowers prolific; but it is not so generally known that many are greatly injured by them, and few farmers are probably aware that humble-bees in some seasons deprive them, it is believed, of a very large proportion of their crop of beans, by puncturing the base of the flowers and rendering the incipient pod entirely or partially abortive. Many garden flowers are similarly attacked by the bees, as larkspurs, azaleas, fuchsias, salvias, snap-dragons, &c. In all probability the pease in the fields do not escape, and in the neighbourhood of Manchester crops of scarlet-beans have been almost destroyed by them.* The cause of the humble-bees thus damaging the crops of beans and flowers arises possibly from some unusually large females, for individuals of the same species vary greatly in size, not being able to creep into many flowers that are too small to admit of their bodies, and too long to allow of their reaching the nectary with their tongues: they are not, however, to be thus baulked of their feast, and instinct directs them to the exact spot on the calyx (No. 50, fig. 1), beneath which the nectar is stored (fig. 2): there they nibble with their strong jaws until they are enabled to introduce their proboscis and obtain the desired treasure. It is surprising, too, that in flowers of a peculiar structure the bees make two holes, to extract the nectar on both sides of the germen, as noticed by Mr. C. Darwin,† who considers the holes made simply to save trouble. The extent of their operations may be imagined by his statement, that in the Zoological Gardens, in August, 1841, "All the flowers of *Salvia Grahami* and the *Antirrhinum*, which I looked at in different parts of the garden, were bored; and out of the many hundreds in bloom in the two large beds of *Stachys* and *Penstemon*, I could not find one without its little orifice, nor did I see one bee crawl in at the mouth."

No. 50.



We must not farther indulge in these garden-walks, but return to the crops. On the 23d of May, 1841, Mr. Gordon, who has the charge of one of the departments in the Horticultural Garden at Chiswick, called my attention to this subject. The broad-beans were full in flower, and he pointed out to me the blossoms which had been perforated by bees. The orifice (fig. 2) was invariably on the upper side of the calyx and near the centre, or a little more towards the base; the incision passed through the calyx, as well as the upper lobe of the flower, into the nectary containing the honey, which proved a great detriment to the crop, for the punctured flowers cannot perfect all the beans in the seed-vessel, or the pod proves altogether abortive, and out of clusters of from five to eight flowers only one or two had escaped the injury.

* Mr. W. Charlton, in the *Gardeners' Chronicle*, vol. i. p. 596. † Ibid. p. 550.

On a subsequent visit I found many pods with a rough brown wound near the base, or they were distorted and deficient of beans, having only two or three at a distance from the puncture.* In the same year the horse-beans were in some places attacked to a great extent, and I was amused in the middle of June at witnessing the investigations to which a female humble-bee (*Bombus lucorum*) subjected the flowers, flying from one bean to another, at last alighting with its head over the calyx, just putting its nose to the artificial aperture, and bustling off in a moment to others. From this movement I am led to presume that the sound flowers it left unnibbled were too far advanced, or from some other cause contained no honey, and that the wounded ones continue to secrete the nectar after they have been tapped.

The humble-bees form one of the finest groups of British bees, whether we consider their size or the rich contrast of colour they exhibit; and from the genus containing nearly forty species,† each composed of males, females, and neuters, there is great variety amongst them, and their specific distinctions are often complicated. We need however only regard two species, which were detected in the act of robbing the beans, as we have stated, namely, *Bombus terrestris* and *B. lucorum*.

All bees belong to an order called HYMENOPTERA, forming the family APIDÆ, and the two before us are included in the genus BOMBUS; the first species was named by Linnæus—

4. *B. terrestris*.—The Earth-bee: fig. 3.—The females and workers, which are the most abundant, are only to be distinguished by their size, the former being much the larger, sometimes measuring 1¾ of an inch when the wings are expanded; they are densely clothed with the finest hairs of the deepest black, with three bright ochreous bands; the head is short, black, and punctured, the face is oval, the nose bare, with a broad notched labrum, beneath which are two strong mandibles which cross in repose, rounded, and more or less notched internally towards the apex; below these is concealed the proboscis, composed of two strong horny pointed valves called the lobes of the maxillæ, which have minute palpi at the base; between these is placed an elongated chin, which enables the bee to contract or lengthen the tongue, which is long, linear, and rough at the apex, to absorb the honey; on either side is a very long palpus or feeler, attached to short joints called scapes; the next joint is very long, producing an elongated acute joint, to the apex of which is attached a slender portion, divided into two joints;‡ the eyes are large, long, and vertical; three ocelli, or little eyes, form a transverse line on the crown; and below them at the middle of the face are inserted two antennæ, which are longer

* *Gardeners' Chronicle*, vol. i. p. 485.

† Curtis's *Guide*, Genus 723.

‡ Ample dissections of the various organs will be found in Curtis's *British Entomology*, Plate 564.

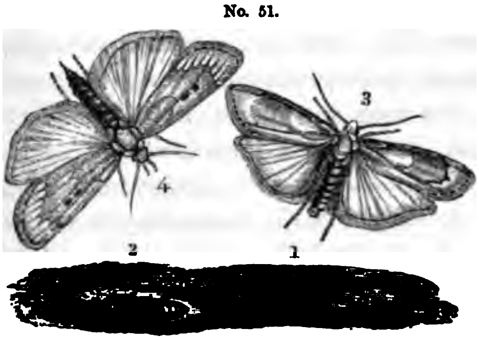
than the *head,* dull black, thread-shaped, and twelve-jointed; the basal joint is the longest, and forms an angle with the remainder, the second is minute, third longer, the following short, the apex rounded and wedge-shaped: the thorax is sub-globose, with a broad ochreous band in front; scutel large, transverse, semi-ovate: abdomen very large, oval, convex, the second segment and two or three of the apical ones deep ochreous: wings four, tinged with yellowish brown, the nervures pitchy; superior ample, with a long marginal, three submarginal, and three large discoidal cells; inferior wings much smaller: legs six, very strong, hinder the largest; shanks, anterior short, convex externally, as well as the intermediate, each with a spine at the apex, hinder compressed, very shining outside, greatly dilated, the edges ciliated, the interior angle with two spines; feet long and brown, basal joint very large, compressed, greatly dilated, and glossy in the hinder, with a strong tooth outside at the base, three following joints small, fifth clavate, terminated by a pair of strong claws, furcate internally. In old specimens the yellow bands are often brighter, and the tip of the body is quite white. The male is distinguished by having thirteen-jointed antennæ, and no tooth at the base of the first joint of the hinder feet; the face is shorter, and the nose clothed with a mixture of yellow and black hairs. It is considerably less than the female, but many of the working-bees or neuters are much smaller.

5. *B. lucorum* of Linnæus—the Wood-bee: fig. 4.—It is similar in form to the foregoing species, and the males are the same size. They are black; the nose and crown of the head are clothed with bright yellow hairs; there is a band of the same on the fore part of the thorax and the base of the abdomen, including the scutellum; the apical segments are clothed with pure white hairs, having a black band across the middle of the body; the hairs on the under side are principally yellow; the feet, excepting the broad basal joint, are rust-coloured.

Humble-bees form their nests in old loose walls, amongst broken bricks, and stones shot down as rubbish, in banks, at the roots of trees, &c. During the first fine days of spring, or even earlier, the females, which often pass the winter in mossy banks, come forth to collect honey and pollen from the catkins of the willow; later in the season the neuters become active, but the males are not abundant until the autumn. In the summer humble-bees may be seen collecting moss for the purpose of covering their nests, which are sometimes lined with wax. The comb is irregular, and formed of brown oval cocoons made of a kind of silk daubed with wax, amounting sometimes to sixty, being adapted in size to the three sexes. If, therefore, it be desirable to stop the mischief caused by these animals, the nests must be destroyed at the end of summer, and the females collected as they come out in the spring.

Humble-bees, however, have many natural enemies amongst the feathered tribes, especially the butcher-bird, *Lanius colluris*, which impales them on thorns; there is also a dipterous fly of great beauty, named *Volucella inanis*, which, hovering about woods from June to the end of August, deposits its eggs in the humble-bees' nests, and the larvæ live upon the brood of the bees. The most formidable foe, however, is the caterpillar of a moth called *Ilythia colonella*,* which feeds upon the honey, and when full fed, spins a web of a close woolly texture (No. 51, fig. 1), so tough that I could not rend it in pieces, and within these the caterpillars change to chrysalides: fig. 2. The female moth creeps into the nest in June to deposit her eggs, and the caterpillars live in families sometimes of 500, to the total destruction of the progeny of the poor humble-bees. The moths are of a dirty white, the upper wings have a greenish and rosy tinge, with a line of black dots round the margin, a whitish space near the base, and two black lines near the pinion-edge in the male: fig. 3. The female has two distinct indented transverse bars, with two black dots on the disc: fig. 4; the under wings are smoky. Probably these checks are sufficient to keep this tribe of insects under without the intervention of man, and by pushing persecution too far, it is not unlikely that "in avoiding Scylla we might fall on Charybdis;" for if the humble-bees could be extirpated, in all probability the beans would not be so prolific, and by the destruction of some flowers it is almost certain that those which escape form larger and finer pods and seeds. These are fit subjects for the cultivator to investigate, and into his hands we consign the subject. Hive-bees have been accused also of assisting in puncturing the flowers, but Mr. Darwin thinks they only participate in taking advantage of the labours of their bustling neighbours, as they do not exhibit the adroitness which the humble-bees do in detecting the hidden treasure.

No. 51.



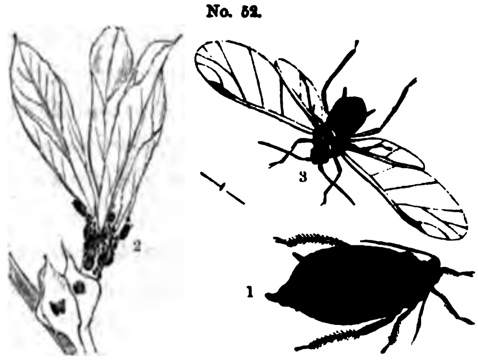
The beautiful Rose-chafer, *Cetonia aurata*, described and figured in a former chapter,† is sometimes abundant on the bean flowers in Dorsetshire, as observed by Mr. Dale; and as these beetles feed upon the pollen and nectar of flowers, little doubt can be entertained that their presence does not benefit the crop.

* Hubner's *Samlung Europaischen Schmetterlinge Tineæ*. Plate 4, f. 22 male, f. 23 female.
† Chapter iv. page 107.

APHIDES, OR PLANT-LICE.

Another tribe of insects we have to record which destroy or injure the pease and beans in the field, are the *Aphides*, from which no crop is entirely free; the former of these plants are often smothered with the "lice," or "green dolphin," as they are termed, and the latter seldom escape from the attacks of another species; these from their sooty colour, have received the appellation of black-fly, black dolphin, or collier. Like all the insects of this family, of which we have already described many, their first appearance is very sudden, and their increase so prodigious, that crops suffer severely from their visits. In 1833 the beans were almost totally destroyed by them in Yorkshire. In 1841 they were abundant in my garden near the Regent's Park; but in 1842 I never saw one on the spot, yet the beans around Sandgate in the same year were very much injured by them. On the 5th of June, 1846, I could only find apterous specimens (No. 52, fig. 1, highly magnified) on the broad-bean tops (fig. 2); but on the 11th I detected some winged specimens (fig. 3, the cross lines show the natural size), and the beans in the potato rows were smothered with them, whilst those in a separate bed were free, and by topping them the crop escaped.

No. 52.



Dickson says, "In such summers as are dry, beans are frequently liable to be much injured by the attacks of the *black-fly*, or what is often termed the *dolphin*, the whole field in particular cases being in danger of being destroyed in the course of a few days. In order to prevent this mischief it is the practice in some places to cut off the tops by means of a scythe or other sharp implement, as it is mostly on the tops of the plants that the insect first appears. When this method is adopted it should be performed on the very first appearance of the fly, otherwise little benefit can be produced; as, perhaps, by removing the first insects that show themselves, their propagation may in some degree be prevented."* I have little more to add than to confirm Mr. Dickson's sensible observations, and the excellence of the remedy he proposed, which is now practised by all good cultivators, I believe. Late in the year I have seen the colliers on the under side of French and scarlet

* Dickson's *Practical Agriculture*, vol. ii. p. 597.

bean leaves, and in the mild autumn of 1846 they were observed upon the latter plants during the last week in October. Where the eggs are laid by the *Aphides* remains a mystery. It cannot be upon the beans, and as the apterous specimens are the precursors of the winged ones, as far as my observations have gone, they are not able to transport themselves in the first instance. Having once established themselves upon the bean-tops, their multiplication is no longer mysterious, for, being then viviparous, they breed at a rate which would be incredible, if it were not well attested.* As the Colliers are readily detected by their peculiar colour, often making the bean-stalks as black as soot, no one can find any excuse for neglecting to apply the remedy of removing the tops on the first indication of their presence. This, however, is not all that is required, for if they be not collected and burned as the operator proceeds, the animals will soon crawl to the living plants, and those that have wings will fly away as the tops wither. Troublesome, if not expensive, as the method would be, I should recommend the employment of women and children to cut or pinch off the tops of the beans into skeps, heaping them up at one end or corner of the field and burning them as the work proceeds, or they might be thrown into a pit and trampled down with unslaked lime.

The *Aphides* exhaust the plants by sucking the sap, so that when they abound, it is in vain to calculate upon a good crop, if they be not speedily arrested. The lady-birds and their black larvæ † soon come to the aid of the farmer and destroy immense quantities, as well as the maggots of two-winged flies, ‡ and minute *Ichneumonidæ* puncture the apterous females, as they do other plant-lice, § and where such agents are ascertained to be numerous, perhaps the reduction of the noxious animals may be safely intrusted to their instinct; but I may here again notice the utility, and even necessity, of agriculturists being acquainted, to a certain extent at least, with the species of insects inhabiting their fields; for Mr. Middleton || acknowledges that he did not know whether the lady-birds are the parents or the destroyers of the black aphides so injurious to the beans. This, however, is many years since, and I trust that no one who discusses agricultural subjects in future will be thus compelled to confess his ignorance. It only remains now to describe the colliers.

They belong to the order HOMOPTERA, the family APHIDES, and the genus APHIS, and from the species living upon the common bean called *Vicia faba*, it has been named by Scopoli—

* See chapter iii. p. 66.

† Coccinella, chapter iii. p. 71.

‡ Scæva, chapter iii. p. 80.

§ Aphidius, &c., chapter iii. p. 73.

|| *Agriculture of Middlesex*, page 192.

6. *A. fabæ.*—Female apterous, ovate, sooty black; antennæ shorter than the body, tawny, except at the extremity, setaceous, indistinctly seven-jointed, two basal joints minute, three following elongated, terminal one slender: rostrum bent under the breast in repose, rather long and stoutish: eyes prominent: abdomen with bluish white spots down each side of the segments; tubes short. Six legs stoutish, ochreous, shining; thighs more or less pitchy; shanks pubescent, pitchy at the apex, hinder the longest and curved; feet short, black, and biarticulate, terminated by minute claws: fig. 1, magnified. In some examples the head is ochreous and the legs entirely of the same colour, whilst a few are of a rusty colour. Males? winged and black: head trigonate; eyes prominent; antennæ as long as the body, slender, setaceous, tawny at the base, distinctly seven-jointed, two basal joints very short, third the longest, sixth much shorter than the fifth and seventh: thorax shining, deeply channelled, forming four convex lobes including the broad scutellum; the collar is very short, but forming lateral lobes: abdomen oval, not broader than the thorax; the tubes are longer and slenderer than in the apterous sex: four wings deflexed in repose, iridescent but slightly tinged with brown; superior very ample, thrice as long as the body; the nervures and stigma are pale brown, the apical cell ovate-conic, with a double furcate one below it; inferior wings small: legs pubescent, ochreous, rather long and slender, especially the hinder pair; thighs more or less pitchy, as well as the extremities of the tibiæ; the feet are black, short, and slender, having a minute basal joint and two little claws at the apex: fig. 3, highly magnified.

BRUCHIDÆ—*the Pea and Bean-beetles.*

Pease and beans are often inoculated in the field by a group of beetles, called improperly "Bugs" by the farmers; and this subjects them, like the cereal crops, to great injury and waste after they are stacked or housed. From their destructive nibbling propensities, these beetles have received the appellation of *Bruchus.* It is singular that they should be almost confined to leguminous or pod-bearing plants, infesting various kinds of pulse and many foreign seeds which are of great value to the inhabitants, either for home consumption or as articles of commerce; amongst them are recorded acacias, mimosas, and some palm fruits.* A leguminous seed named Gram, and much used when boiled as food for horses in the East Indies, is consumed by them.† In Carthagena the ravages of a species of *Bruchus* are serious upon the seeds of the Dividivi or Libidibi, the legumes of which are so valuable a substitute

* Latreille, *Hist. Nat*, vol. xi. page 401.

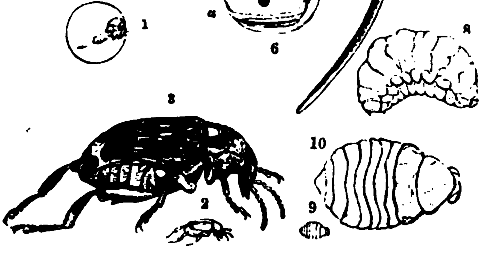
† Kirby and Spence's *Introduction to Entom.*, sixth edit. vol. i. p. 143; and seventh edit. p. 97.

both for oak-bark and galls.* In a considerable sample of those seeds which I obtained, I scarcely found one that had not either contained a *Bruchus* or in which I did not find one dead.

Happily in England there are but few native species of this genus, and of those only one or two commit any havoc on the crops. Before entering upon their history I must not forget to make the cultivator acquainted with one which has found its way from North America into the southern states of Europe, and has become naturalized in the warmer departments of France. It is to be hoped that our climate will not suit the economy of this pest, for I have frequently found the beetles in imported pease.† The first notice we have of this insect was from M. Kalm, a Swedish traveller, who stated‡ that in Pennsylvania, New Jersey, and the southern parts of New York, this beetle, or rather its maggots, were making such ravages amongst the pease, that the inhabitants had been obliged to abandon the culture of that excellent and useful pulse.

As the economy of this species has been well investigated, I shall relate what has been published regarding it. The beetles pair in summer, whilst the pease are in flower and producing pods; the females then deposit an egg in almost every pea which has just formed. From the outside of these peas, when arrived at maturity, they do not appear damaged, but on opening them one generally finds a very little larva, which, if left to repose, remains there all the winter and part of the following summer, consuming by degrees all the internal substance of the pea, so that in the spring the skin only remains, after which it is transformed into an insect with scaly wing-cases, which pierces a hole in the skin of the pea, from whence it comes forth (No. 53, fig. 1), and resorts to the fields sowed with that pulse, in order to deposit its eggs in the new pods.§ I think it is Dr.

No. 53.



Harris who says that "the eggs are laid only during the night or in cloudy weather; that each egg is always placed opposite to a pea; that the grubs, as soon as they are hatched, penetrate the pod and bury themselves in the

* *Trans. Ent. Soc.*, vol. i. page xxiv.

† Those from Odessa are, I think, the worst.

‡ *Voyage en Amerique*, vol. ii. page 294.

§ De Geer's *Mémoires*, vol. v. page 280.

pea; and the holes through which they pass are so fine as hardly to be perceived, and are soon closed."* Latreille asserts that if the summer has been hot, the beetles are disclosed the following autumn, and that the seeds will grow notwithstanding their inhabitants, which spare, owing to a wonderful instinct, the vital germ of the pea.†

We can find nowhere any description of the egg. The larvæ have a soft whitish body, composed of many indistinct segments, and are apodes or only have some very minute feet. Their head is small, scaly, and armed with strong and sharp-cutting mandibles. They have nine spiracles on each side for breathing. Before changing to pupæ the maggot eats a round hole from its cell to the rind of the pea, which in all probability it partially cuts through with its jaws, so that when the beetle shakes off the shroud which envelops it, by a slight dilatation of the body, the head is forced against this circular lid, which instantly gives way, and the new-born *Bruchus* comes forth, as represented in fig. 1. In a great number of the peas the beetles will be found dead; but whether this arises from a lower temperature than they are accustomed to, not invigorating them sufficiently to leave their habitations, or whether they return to feed when they cannot make their escape readily, which may be the case when confined in sacks or heaped up in warehouses, I am not able to determine.

These beetles belong to the order COLEOPTERA, the family BRUCHIDÆ, and the genus BRUCHUS. The species alluded to was named by Linnæus—

7. *Bruchus pisi*—the Pea *Bruchus.*—It is thickly punctured, black, densely clothed with short brightish brown hairs above, more gray and silky beneath: head rather small and drooping, ovate, with a distinct narrow neck; the nose narrowed and flattened, at the extremity of which is placed the mouth; this is composed of a crescent-shaped labrum, two trigonate fulvous mandibles, partially serrated internally; two jaws formed of two long hairy lobes, and producing four-jointed black palpi; and of a broad bilobed chin, producing a large lip dilated before, from near the centre of which arise two triarticulate palpi:‡ the eyes are black, prominent, and lunate, having a deep notch below, where the antennæ are inserted; these are not longer than the thorax, clavate, and eleven-jointed, the four basal joints are bright fulvous, the first is oblong, second the smallest, ovate, third and fourth obtrigonate, the following much larger, cup-shaped, terminal joint ovate: the thorax is twice as broad as the head, transverse, semi-orbicular, the anterior margin a little concave, the hinder bisinuated, the angles acute; the sides with a little notch at the middle, forming a minute tooth, and there is a slight transverse

* *Treatise on Insects.*

† This is the case with the beans also. J. C.

‡ These dissections are figured in Curtis's *British Entomology*, Plate 754.

ridge across the middle; it is variegated with orange hairs, the lateral teeth white; there is a white spot before the scutel inclosed by a subquadrate black space; the scutel is minute and white: the wing-cases are considerably broader than the thorax, nearly flat, oblong, with ten fine striæ on each; there is a white dot on the second interstice on each side of the suture towards the base, and a wavy transverse line of broken white dots beyond the middle, surrounded by black spots and patches, especially towards the apex, which bears two pale dots; wings ample and folded: abdomen extending beyond the elytra, convex, and sloped off, forming a large semi-ovate apical joint called the pygidium, clothed with grayish pubescence, bearing two black or brown spots at the base more or less concealed, and two black shining ones near the apex; under side silky and slate-coloured, a whitish spot at the hinder angles of the pleuræ, and a white lateral dot on each of the five following abdominal segments: legs clothed with silky gray pubescence; hinder pair very long, with the thighs stout, having a minute tooth beneath near the apex; the shanks bidentate at the apex; the other four legs are much shorter and slenderer, with the tibiæ and tarsi tawny; the feet are four-jointed, the hinder long and black, the basal joint greatly elongated, third joint bilobed, fourth clavate; claws small, hooked at the base. Length from 2 lines to 2½: fig. 2; fig. 3, highly magnified.

The *Bruchus* which abounds in this country in our fields and gardens, if not originally a native species, is at any rate perfectly naturalized, and the importation of foreign pease and beans for seed, is annually increasing the numbers. Some foreign long-pod beans which I purchased in the spring of 1846 were infested to a great extent. I picked out, as far as I was able, those which contained insects and planted the rest, yet I saw a few of the *Bruchi* running over the bean-flowers in the month of June. This species received from Linnæus the name of—

8. *Bruchus granarius*—the Grain *Bruchus*.—It is smaller than *B. pisi*, being generally less than 2 lines in length (fig. 4); but is very similar in form. It is black and punctured, but less densely clothed with short brown hairs; the antennæ are not so much incrassated at the extremity, but the four basal joints are ferruginous: the thorax is not so broad, and more bell-shaped; the lateral tooth is very indistinct; and, besides the white hinder angles and the triangular spot before the scutel, there are two white dots on the disc: the wing-cases are sprinkled with whitish spots of hairs, the suture forms a brown stripe, whitish at the base; there are four white dots on the disc, separated by a black longitudinal line; the wings are ample: the exposed apical joint of the abdomen, called the pygidium, is densely clothed with grayish pubescence, in certain lights exhibiting four minute indistinct dark

dots: the under side is similarly spotted: the legs differ in having the first pair only ferruginous, with the thighs of the same colour, excepting the base, and the hinder shanks have the internal spine elongated: fig. 5, magnified. Specimens of this insect are frequently so rubbed that they appear almost entirely black, from the hairs or pubescence being worn off.

This species, which is everywhere abundant as early as February on the furze when it is in bloom, inhabiting also the flowers of various other plants in the beetle state, as the rhubarb, meadow-sweet (*Spiræa ulmaria*), &c.,* is a most destructive insect in our pea and bean fields, the larvæ feeding in the seeds and sometimes destroying more than half the crop. They are exceedingly abundant in some parts of Kent, where they often swarm at the end of May, and are occasionally found as late as August; indeed I killed one in November, imported with the Russian beans, which had been alive in a box since the end of September. It attempted to fly away in October; it then became torpid, but on warming it by a fire in the middle of November, it was as lively and active as in the height of summer, and I dare say would have lived through the winter.

It is said that the female beetles select the finest pease to deposit their eggs in, and sometimes they infest crops to such an extent that they are eaten up by them, little more than the husk being left. The various kinds of beans are equally subject to their inroads; besides the long-pods I have alluded to, I have had broad Windsor beans sent to me containing these *Bruchi;* and Mr. C. Parsons transmitted me some horse-beans in the beginning of August, 1842, which were entirely destroyed by them. Mr. F. J. Graham showed me some seed-beans which were inoculated by these beetles to a great extent, and some of them were alive in the seeds; yet to any one ignorant of the economy of this pest, there would not appear the slightest external indication of their operations. I also received from a gentleman residing in Norfolk a sample of seed-beans from Russia for winter sowing, a large proportion of which was perforated by this *Bruchus*.

It has already been intimated that as the beetles generally leave the germ uninjured, the vitality of infested seeds is not destroyed.† I doubt, however, if they produce strong healthy plants; and from my own experience I have no doubt, if pease or beans be sown containing the *Bruchus granarius*, that the beetles will hatch in the ground, and thus the cultivator will entail upon himself a succession of diseased pea and bean crops. Now to avoid this loss the

* The larvæ are also recorded as inhabiting the lentils in France, likewise gesse, beans, and all sorts of vetches. *Ency. Méthod.*, vol. v. page 198.

† Fig. 11 exhibits a split horse-bean inhabited by *B. granarius* (*b*), which was sown and vegetated, as shown by the radicle.

seed should be examined before sowing, when to an experienced eye the presence of these beetles will be discernible, where to a common observer they would appear sound and good. It has been shown in the history of the foregoing species that the maggots, when arrived at their full size, gnaw a circular hole to the husk or skin of the seed, whether pea or bean, and even cut round the inner surface which covers the aperture, so that a slight pressure from within will force this lid off: these spots are of a different colour to the rest of the seed, generally having a less opaque appearance, and often are of a duller tint: on picking off this little lid, a cavity will be found beneath, containing either a maggot (fig. 7, 8 magnified), pupa (fig. 9, 10 magnified), or beetle. On splitting one of the horse-beans (fig. 6), I found a pupa in the cell (fig. *a*), but most of them were occupied by the perfect insects. At a more advanced period the beans tell their own story, by the holes which are visible from whence the beetles had escaped or are ready to do so: on these beans were little dark dots, looking as if they had been made with a red-hot needle, which I have frequently observed in other samples; at this point the husk is generally indented and sometimes quite perforated. Whether these are caused by efforts of the larvæ to penetrate the seeds when first hatched from the egg, or from parasitic ichneumons searching with their oviducts for a nidus for their ova, I cannot say. From the large horse-beans most of the beetles had escaped, and their cells were occupied by other maggots, which will shortly deserve our attention.

There is another important but neglected question to which we have more than once alluded in this volume,* namely, the effect of extensively infested crops upon the constitution and health of those who feed upon them, whether animals or man. We learn from the authors of the *Introduction to Entomology,*† that M. Amoreux, a French author, alludes to "an alarm that was spread in some parts of France, in 1780, that people had been poisoned by eating worm-eaten pease, and they were forbidden by authority to be exposed for sale in the market; but (it is added) the fears of the public were soon removed by the examination of some scientific men, who found the cause of the injury to be the insect of which I am now speaking (*Bruchus pisi*)." Here is an admission of an injury done to the public by pease infested with the *Bruchus pisi;* and in December, 1845, I received a communication from the secretary of the Royal Polytechnic Institution, bearing directly upon this subject. Mr. Longbottom says, "I have been requested by the Bishop of Norwich to forward for your inspection the accompanying sample of beans lately brought from Sicily. They were pur-

* Chapter xi. page 335. † Sixth edition, vol. i. p. 143; and seventh edition, p. 96.

chased by a cabriolet proprietor for his horses, but finding that the health of the animals was much deranged from feeding on them, they were carefully examined, and almost all of them found to contain an insect."*

This sample of broad-beans, amounting to thirty-seven, contained sixteen that were infested by a *Bruchus*, some having only one, others two and three in each, and about six or seven of the beetles were alive at the time. I found also one full-grown maggot, and a parasitic fly in a cell lined with a shining membrane. The beans with few exceptions appeared sound outside; but on a more searching examination pale or horny spots were discoverable on the skin, or a little space marked merely by a delicate circular line indicating what might be expected beneath, as exhibited higher up in the same figure. There were occasionally pitchy dots or punctures, which possibly might be the spot where an egg had been deposited, for in some instances the incision entered the farinaceous substance of the bean, and in others a small maggot had been feeding in his little cell, but from the size and form of the head I do not think it was the larva of the *Bruchus:* rarely a larger hole was visible, which had been eaten by the beetle preparatory to its escaping from the cell, immediately on its bursting from its pupa shroud. On cutting open the beans, some contained two, three, and even four cells; in a few were larvæ of various sizes, in which case there was a good deal of farinaceous powder around them; others contained the beetle just changed, with the elytra not expanded; but in most of the cavities I found the perfect *Bruchus*, with its head downward, and next the transparent spot, with the excrement and debris left by the maggot at the opposite end. Generally speaking, the portion where the germ of the seed is situated was left untouched, but occasionally the cell did extend to that part.

The maggots were like that already described—fleshy, wrinkled, with a minute, horny, ferruginous head, and their ochreous colour might be owing to their being dead. The pupæ were, I believe, all dead, and presented various stages of development, some showing but faint traces of the future beetle, and others having every member perfectly formed. This beetle, which is a different species to any I have seen in the other samples, has been named by Schönherr †—

9. *Bruchus flavimanus.*—It is similar in size to *B. pisi*, but formed more

* I have since learned that the ceiling of the loft where the beans were kept was covered with flies, as the owner called them, but they were, I have every reason to believe, the "Grain Bruchus." Another cargo of 1000 quarters of large beans, imported from Sicily to Newcastle-on-Tyne, in September, 1850, was so infested, that the meal after passing through the millstones was apparently alive with the beetles, which took wing and flew about the mill in thousands; and there were from three to five insects in many of the beans.

† *Genera et Species Curculionidum*, vol. i. page 59.

like *B. granarius:* it is black; the head and thorax are clothed with short orange-coloured hairs, having a distinct cream-coloured triangular spot before the scutellum, which is of the same colour; there are two minute white dots on the disk; the lateral teeth are acute and pale: the wing-cases are of an ashy white, with a few brown spots; the suture is ochreous white, and there are four white dots on the disk: the exposed apical segment of the abdomen is ochreous white, with two oval olive-brown spots near the apex: on the under side, which is silky slate colour, is a pale line under the shoulder of the elytra, and a row of white abdominal dots, as in *B. granarius:* the anterior pair of legs and four basal joints of the antennæ are bright ferruginous, the apical joint of the former brown; the other legs are clothed with fine ochreous hairs, and the hinder are notched and spurred like those of *B. granarius.* Old specimens are black, and clothed with gray pubescence, the upper and under sides being often of the same colour.

From the number of the beetles in the beans, this species seems to be the most destructive of all; but from the comparatively cold temperature of England, I expect our climate will not suit it, and therefore nothing need be apprehended by our agriculturists from its operations; but in purchasing beans for seed or food, good judgment should be exercised, and this may easily be acquired if a person will attend to our suggestions.

Before entering upon the remedies recommended by authors, I may mention that, as usual, the parasitic flies are employed to a great extent in keeping down the multiplication of the *Bruchi.* I have already discovered three species which no doubt puncture the maggots in their cells, depositing the eggs in their bodies, which hatch and feed upon the larvæ of the *Bruchi.** They all belong to the order HYMENOPTERA, the family ICHNEUMONIDES ADSCITI, or ALYSIIDÆ, and two of them to the genus SIGALPHUS, and appear to be identical with a species named by Nees ab Essenbeck †—

10. *S. pallipes.*—The *female* is black, shining, and similar to *S. caudatus,*‡ but it is larger, and the ovipositor is shorter: the head is somewhat globose; the antennæ are as long as the body, composed of twenty-two joints; basal joint the stoutest, but not longer than the third or fourth; the terminal joints globose: abdomen short, oval, with three striated segments, the striæ vanishing towards the apex, which is finely punctured; ovipositor as long as the abdomen, the central oviduct ochreous; nervures of wings and stigma like those of *S. caudatus:* legs stoutish, bright ochreous; apex of hinder tibiæ and all the tarsi brown: length, 2 lines, including the ovipositor; expanse, 3 lines.

* Nees ab Essenbeck says they puncture the eggs of the parasites.

† *Hymenoptera Ichneumonibus affinia,* vol. i. page 270.

‡ Chapter viii., Plate H, fig. 19.

This is an abundant insect in England in the summer months. A female was taken from a cell of *Bruchus granarius* in the Russian beans,* and a female of the following species from one of the Sicilian beans. As I cannot find it described, I have given it the name of—

11. *S. thoracicus.*—It is similar in size and form to *S. pallipes*, but the thorax is of a red colour: all the legs are bright ochreous, the feet tipped with fuscous: the head was broken off and lost.

The parasitic fly which I have frequently found with the *Bruchus granarius* is much smaller than the foregoing species: it belongs to Mr. Haliday's genus CHREMYLUS,† and is named by Nees ab Essenbeck *Hormius rubiginosus.*‡ It is also serviceable in destroying wood-boring beetles which infest our houses.

12. *C. rubiginosus.*—*Male* shining, dull chesnut colour; head large, black, sub-globose, finely punctured; eyes not large, lateral, but placed rather forward; ocelli three, forming a triangle on the crown: antennæ as long as the thorax, ochreous, slender, and eleven-jointed in the male; two basal joints stout, third and following oblong-ovate: thorax as broad as the head, elongate-obovate; metathorax rugose, the hinder angles tuberculated: abdomen not longer than the thorax, small, oval, depressed, more ochreous, fuscous at the apex, which is very smooth and shining, with two distinct segments, and two carinæ or longitudinal ridges at the base: the four wings are of moderate size, tinted with ochreous-brown; the nervures are very indistinct, the stigma tawny; the legs are stoutish and pale ochreous; the feet taper, and are five-jointed, terminated by minute lobes. It is scarcely ½ a line long, and the wings expand about ⅘ of a line. The *female* is four times as large, being 1 line long, and 2 lines in expanse: the head is moderately large, thickly punctured, and does not shine: the antennæ are twelve-jointed: the thorax is broader than the head, sometimes black or partially of that colour in front; the metathorax has two ridges behind: the abdomen is very thickly punctured, especially on the disk and at the base; the carinæ are very sharp, and the second segment very large; ovipositor shorter than the abdomen: superior wings with a large elliptical fulvous stigma, nervures ochreous, with a very large marginal cell, three submarginal, and a discoidal one.

Useful as these checks are, it is not in our power to command their services: their destiny is to prevent the total destruction of the crops of pease and beans from the ravages of the *Bruchi*, and it is left for the ingenuity of man to devise means of preservation, which, when well directed and perse-

* I subsequently detected numbers of these parasites in the long-pods from my own garden.—J. C.

† *Entomological Magazine*, vol. iv. page 50.

‡ *Hymenoptera Ichneumonibus affinia*, vol. i. page 156.

vered in, will generally reward his labour. It has been already stated that in Kent these insects are most abundant; from this fact it may be inferred that chalky districts suit the economy of the *Bruchi* in some way, either by favouring their transformations, or in producing wild flowers that are attractive to the beetles.* It would be worth while ascertaining what is the period for sowing pease and beans in the infested districts, as by some opposite course it is possible the increase of the beetles might be checked. Late sowing I apprehend would be the most dangerous, as the insects would then be committed to the earth with the seed, when they would not suffer from too low a temperature, but would come forth strong, active, ready to pair, and pursue their economy unrestrained. In May and June, as the summer approaches, the beetles have generally hatched or died in the seeds, and consequently they are free from this objection; and thus arises the opinion that if pease be kept over the year they become entirely free from the pest. Cultivators very properly prefer employing seed from a distant locality to using their own, but in this way land may be infested with insects which prey upon the fruit of a plant, and owing to our climate not perfecting some seeds regularly, as well as to the abundant supply at a cheaper rate from the coasts of the Mediterranean, the gardener especially has to rely upon a foreign market, and, as we have just shown, seeds from southern climates being greatly and constantly infested by insects, we are annually introducing the plagues, perhaps, of Egypt into our fields and magazines.† It has been observed in a New York newspaper, that beans and pease imported from foreign parts are always worm-eaten, whereas those grown and used in the same country are free from worm. What can be the reason of this? says the commentator.‡ Perhaps, I am near the truth in saying that it is because imported pease and beans for seed may always be traced to a southern source.

The direct remedies are evidently limited, and require a few experiments to be first made to obtain a habit of application, which experience would soon teach those who are actually interested in the cultivation of pease and beans. It is recommended in Hovey's *Magazine of Agriculture*, "Immediately after gathering the seeds, to subject them to the action of boiling water for one minute: by this means the little larvæ are destroyed, which are at this time just below the integuments of the pea, without destroying the vitality of the seeds. If the pease remain in the boiling water four minutes, most of them will be killed, but not all; of about forty peas thus heated last

* *Bruchus cisti*, another British species, is exceedingly attached to chalky districts, from the *Cistus helianthemum* abounding on such soils, in the flowers of which it lives.

† The bean (*Vicia faba*) is a native of Egypt, and the pea (*Pisum sativum*) of the south of Europe.

‡ *Gardener's Magazine*, vol. iv. page 448.

year, three vegetated, and are now growing."* It is now more than half a century since the celebrated Olivier recommended this method in France; and I shall conclude this portion of my subject by translating his observations:— "As the waste which the *Bruchi* occasion is more particularly injurious to cultivation and the food of the people, we ought to be so much the more desirous of finding some suitable means of preventing it. One of the modes, without doubt the most efficacious, would be to plunge into boiling water the different seeds which they attack, as soon as the gathering them is completed. But it is indispensable that all should be subjected to this immersion, in order to kill all the larvæ which they contain, and entirely to destroy the propagation of a family so prejudicial. One could also apply to these legumes a heat of from 45° to 50°† in a kiln or oven: this heat, without altering them, would be sufficient to kill the larvæ. One well knows that these two means ought not to be practised upon grain destined for reproduction. We shall obtain the same object if we take off, immediately after the gathering, the husks of those legumes which are intended for winter provisions, and if we leave the two cotyledons, or halves of the seed naked."‡ I would merely add that immersing the pease and beans in the commonest oil would, perhaps, destroy the insects without injuring the vitality of the seeds; but this remains to be ascertained.

TINEA SARCITELLA—*the Sack or White-shouldered Woollen-moth.*

The economy of this little insect is somewhat like the wolf or grain moth,§ for the larvæ will indiscriminately feed upon vegetable and animal substances. They frequently assist in the destruction of pease and beans when housed, which were previously infested by the *Bruchi*, as we shall soon have an opportunity of showing by the communications of various parties. In April, 1842, I received a letter from Mr. C. Parsons, dated East Tilbury, Essex, saying, "In the inclosed box are some beans, which, from standing in the sacks a twelvemonth, are injured in the way you will see by beetles,‖ of which you will find some by cutting into the beans; and the sacks are so strongly cemented together by the larvæ I have inclosed, that some of them actually require the strength of two men to part them." These were the caterpillars of the *Tinea sarcitella:* No. 54, fig. 1; 2, the same magnified. In December of the same year I received a similar complaint from P. B., who observed, that "from the wetness of last season some beans were got into a store in damp condition and bred moths. As soon as the men could be

* *Gardeners' Chronicle*, vol. i. page 815.

† Of Reaumur, or 133° to 144° of Fah.

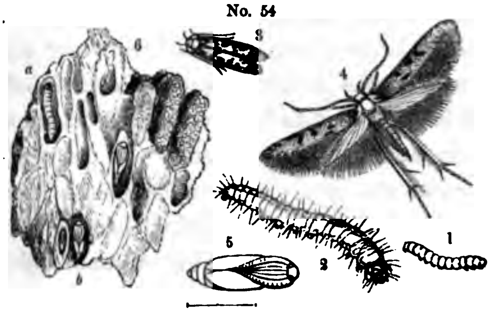
‡ *Hist. Nat. des Ins.* vol. iv. No. 79, page 3.

§ Chapter xi. page 315.

‖ *Bruchus granarius*, described in a previous page. See No. 53, figs. 4 and 5.

spared, the beans were cleared off and their receptacles whitewashed; but I now find that amongst some piles of sacks of pease these insects, in the grub state, have introduced themselves between the sacks in sticky rings. As this is to no small extent, and there is a considerable quantity of beans and pease about, I wish to know the most effectual and rapid method of destroying this pest, without causing any further damage, by communicating a bad smell, &c., to the grain and sacks." In August, 1845, I heard of a stack of sacks sticking together from the same cause, and in November of that year a gardener in Surrey found living maggots in one of his seed-drawers, in which he had left some dwarf-pease, which were more than he wanted to sow in April, and with them two moths, which were the *Tinea sarcitella*. He squeezed a maggot out of one of the many cases or galleries which were made at the bottom of the drawer and attached to the wood. The pease had been put there for seed in September, 1844. I was not a little surprised at the end of September, 1846, on taking out of a tin canister some bundles of barley which had been infested by the *Chlorops*,* to find a dozen caterpillars of *Tinea sarcitella* and the moth, fig. 3, and 4 magnified. The roots were covered with dry earth, and the stalks and leaves were mouldy, but there was nothing for the larvæ to feed upon excepting the corn, unless they found the pupæ of the *Chlorops* anywhere. The earth amongst the roots was connected by their webs, and many of the caterpillars were full grown.

No. 54



Tinea sarcitella has long been recorded as a most mischievous little moth in our dwelling-houses, where it is common the greater portion of the spring, summer, and autumn. I have frequently observed it on the trunks of fruit-trees in gardens as late as September, and in the house in October and November. Sparrows' nests are also a great harbour for them, as the caterpillars revel amongst the feathers, wool, and rubbish which form the lining, and in this way they are always on the premises, and are constantly entering our sleeping-rooms and other apartments, whenever the windows are left open after sunset.

The female deposits her eggs upon clothes, blankets, curtains, carpets, or any woollen articles on which the larvæ feed, living in cylindrical cases which they form of the materials on which they subsist, covered with their excre-

* Chapter viii., Plate H, figs. 1–10.

ment, and in which they change to pupæ. The caterpillar is a lively, wriggling animal, about half an inch long when full fed (fig. 1); it is soft and white with a yellowish tint, and sparingly clothed with fine longish hairs, sometimes having a slate-coloured stripe down the back arising from the food; the head is horny, of a chesnut brown, and furnished with little strong jaws and minute horns; the first thoracic segment is likewise horny and similar in colour, but paler; it has also six pectoral, eight abdominal, and two anal feet: fig. 2, magnified. The pupa is sometimes inclosed in a distinct tough cocoon, similar in texture to the cases; the pupa is brown and shining (fig. 5), the sheaths inclosing the wings being very long, and the horns and eyes are visible through the horny envelope.

The perfect insect belongs to the order LEPIDOPTERA, the family TINEIDÆ, and the genus TINEA of Linnæus, which, from its great extent, has been divided by modern naturalists into various other groups, one of which I have called LAVERNA,* to which our little moth belongs.

13. *L. sarcitella* of Linnæus shines like silk, being covered with minute slippery scales of an ashy brown colour; the head and thorax are densely clothed with depressed white scales; the eyes and a line across the collar black; the palpi or feelers are long and slender, divaricating and curved upward, composed of three joints, of which the second is longest, stoutest, and clothed with scales; the third long, tapering, and pointed: between them is rolled up the spiral tongue: on each side of the crown are inserted the antennæ, which are as long as the body, like fine bristles and ciliated in the male; the abdomen is silvery ochreous white, tufted at the apex in the male, conical in the female, and terminated by a retractile horny ovipositor: the wings lying flat upon the body when at rest; the superior twice as long as the body, narrow, lanceolate, pale ashy brown, freckled with a darker colour, having a dark-brown patch at the base and another at the middle of the pinion margin; there are also four similar spots about the disk, more or less distinct; the hinder margin is fringed with long ochreous and brown hairs; the inferior wings are shorter, narrow, and lanceolate, of a satiny gray tint beautifully fringed all round, the fringe very long on the inner margin: the legs are tawny white spotted with brown; the fore pair are short, the hinder pair long; the four posterior tibiæ spurred at the apex, the hinder pair very long and hairy, with a long pair of spurs at the middle; feet five-jointed, terminated by minute claws and pulvilli. Fig. 3, the moth at rest; fig. 4, the female flying: natural size, 2½ lines long, 8 in expanse. Fig. 6 shows a small portion of the webs torn off from the sacks, containing the maggots (fig. *a*), and chrysalides in their cells: fig. *b*.

* Curtis's *British Entomology*, fol. and Plate 735.

From a box full of the pease, their webs, and refuse, I bred a parasitic insect belonging to the family ICHNEUMONIDES ADSCITI and the genus BRACON, which, no doubt, lives in its larva state upon the maggots of the moth or its pupæ. It appears to be a variety of Spinola's*—

14. *B. variegator.*—The *female* is black and pubescent; the head is hemispherical, bright ochreous, hinder part black, as well as a spot on the crown encircling the three ocelli; eyes orbicular and brown: antennæ thread-shaped, not so long as the body, with twenty distinct joints, the basal one stoutest and a little elongated: thorax broader than the head, obovate; the shoulders, a square spot on the back, and the scutellum, yellow or bright ochreous: abdomen depressed, oval, rather dilated, being broader than the thorax, but scarcely longer, thickly and minutely punctured, seven-jointed, scooped out at the base, forming a semicircular ridge with an indistinct dorsal one; the sides ferruginous-ochre, especially at the base; the apical segment ochreous, as well as the belly; the ovipositor projects, and is only half as long as the body: four wings ample and smoky; the nervures and an oval stigma pitchy; superior with a large marginal and three submarginal cells, the second oblong-lanceolate: legs reddish-ochreous, hinder shanks dusky at their tips; feet five-jointed, blackish at their tips, the hinder entirely dark: length, 1⅓ line; ovipositor, ⅓ line; expanse, 3½ lines.

I found two females alive in the beginning of November, and they differ little, except in the colour of the legs, from specimens I have taken of both sexes on Hampstead Heath in the end of August. The male resembles the female with the exception of the ovipositor, and the antennæ are a little longer.

I expect the mischief done to the pease and beans, which were rendered useless and very offensive, by the webs and excrement of the caterpillars, was owing to the crops being housed in a damp state, which caused mouldiness or minute fungi to be generated, as fermentation proceeded, amongst the seeds upon which the larvæ fed; or when the cotyledons or kernels softened, they might become an acceptable sustenance for them, as we learn from a French writer† that the caterpillars of *Tinea sarcitella* will feed, amongst various things, upon the *Boleti* of the birch and other trees, as well as in the rotten wood, and I am well aware that they will live upon the moist parts of corks in wine-bottles in cellars. It is therefore very necessary to keep pea and bean stores as dry and well ventilated as possible, and the more damp a place is, the more essential it is to expose seeds stowed there to the air and light.

It would be found very beneficial to air in the sun or kiln-dry sacks to

* *Ins. Liguriæ*, vol. ii. p. 118, and Nees ab Essenbeck, *Hym. Ichn. affinia*, vol. i. p. 89.

† Godart's *Lepidop. de France.*

destroy the innumerable mites, insects, and vermin which often infest them, and if sacks were thus kept sweet and clean, and were only manufactured of hemp or vegetable thread, I am pretty confident they would never be attacked by the *Tinea* caterpillars. Seedsmen, farmers, and gardeners should likewise be most careful not to use old sacks that have been mended with worsted instead of thread, much less any in which wool is spun in the material, as I think I have seen in some of foreign manufacture.

These insects, like all others, may be destroyed by fumigating with sulphur, or by allowing turpentine poured into saucers, to evaporate in the infested magazines; but it might be attended with danger, and is of little use unless the atmospheric air is entirely excluded, by filling every chink in the doors and windows with tow. Where small quantities of seeds are required to be kept merely in bags or drawers, if they be well dusted with pepper, it will preserve them from the attacks of insects, or a few ounces of camphor will answer the same purpose.

GRYLLOTALPA VULGARIS—*the Mole-cricket.*

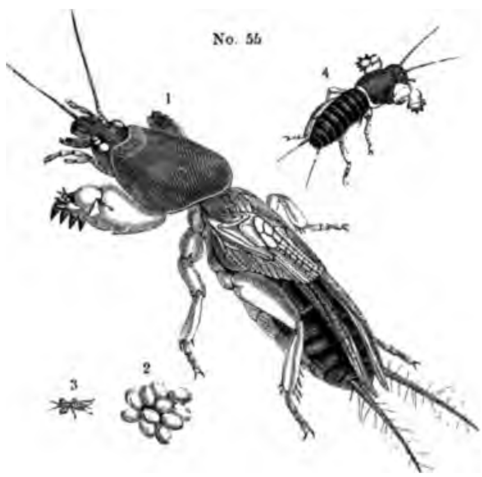
I cannot have a better opportunity than the present of introducing the history of an insect which has ever been so destructive to various crops, that it is a dreadful scourge to the gardener, one of whom, in an old work, said, "Happy are the places where this pest is unknown."* From its remarkable habits of life, extraordinary strength, and large size, its interesting history is as well-known to naturalists as its depredations are to the cultivator.

This animal has received its English names, of Mole-cricket and Earth-crab, from its burrowing like a mole, and some species of West Indian crabs; but it is formed more like a lobster; and, from its supposed jarring song at night, it is also called Eve-churr, Churr-worm, and Jarr-worm. Mole-crickets inhabit every quarter of the globe; in Germany and various parts of the Continent they abound in corn-fields and meadows, where they commit extensive ravages, and are dreaded in the market-garden, eating almost every plant that comes in their way. Although the north of Europe has been tolerably free from them, it appears they are gradually extending their northern bounds, and I am surprised that we have not more evidence of their spoliation in this country, for they are far from uncommon in many places, especially in damp situations, as round the margins of ponds and along the banks of streams. In the south of France, farmers and gardeners complain of the damage their crops of pease and beans sustain from the mole-crickets. In Germany they have been known to destroy one-sixth, and even one-

* *Introduction to Entomology*, vol. i. p. 159, and seventh edition, p. 108.

fourth, of a crop of young corn, by eating off the roots. In the Botanic Garden at Berlin their devastations are so extensive, that duplicates of the more tender and uncommon species of plants require to be kept in pots; and in the West Indies it is stated that a species of mole-cricket has for some years been destroying the pastures all over the Island of St. Vincent, and has now on many estates attacked the young plants and cane-stools.*

The mole-cricket differs from the field and house-crickets very considerably in its economy, for although it resides under ground, it burrows like a mole horizontally, for which its prodigiously strong fore-feet are well adapted, and their strength is well supported by the power of the body and other members; for it is asserted, on the authority of Röesel, that it is capable of propelling six lbs. weight on a smooth surface.† It remains concealed in its burrows during the day, where it can run equally well backward and forward, for which purpose it is provided with two filaments like antennæ at the apex of the abdomen; and when these insects desire to change their abode, they leave it in the evening, and either crawl or fly to another locality; they have the power of leaping also. In these nocturnal peregrinations they are supposed to be luminous, and it has been suggested that the mole-cricket is the notorious "Will-o'-the-wisp," the *ignis fatuus* of bygone days.



This insect belongs to the order ORTHOPTERA, the family ACHETIDÆ, and the genus GRYLLOTALPA, and Latreille has named the species—

15. *G. vulgaris*: No. 55, fig. 1.—It is 2 inches long, without the tails, which are half an inch more, and the wings expand 2½ inches.‡ It is velvety and of a rich brown colour, but more ochreous beneath: the head is conical, and can be drawn into the thorax at pleasure; it is furnished with two prominent eyes, between which are placed two little eyes called ocelli: the two horns are twice as long as the head, inserted in cavities before the eyes, slender and tapering like bristles, but composed of from 60 to 100 minute

* Probably the *Gryllotalpa didactyla*; see *Transactions of the Entomological Society*, vol. ii. p. xi.

† Röesel's *Insecten Belustigung*, vol. ii.

‡ Curtis's *British Entomology*, fol. and Plate 456, where a coloured figure of the female is given, with various dissections of the mouth and other parts.

joints, the basal one the stoutest and oval: the mouth is large, comprising a large, somewhat orbicular, upper lip; two strong, horny, elongated mandibles, curved and acute, with two or three teeth on the inside; two elongated jaws, forming an acute horny lobe, with a smaller sharp one inside, and a long palpiform one outside; the feelers or palpi are long and porrected, composed of five joints, the two basal ones small, third the stoutest, fourth and fifth as long, the latter clavate with a globose fleshy gland at the apex; an under lip, which is elongated and terminated by a heart-shaped fleshy lobe, from the base of which arise two stiff parallel lobes, and on each side a stout, rigid, and pilose one, all of the same length; the two feelers are stout, rigid, and three-jointed, the basal joint sub-globose; second and third long, the latter the stoutest, the apex oval and fleshy. Thorax twice as broad as the head, convex, oval, the anterior margin concave: wing-cases short, somewhat oval, like parchment, yellowish-white externally, brown internally, partially covering one another in repose, with numerous strong longitudinal oblique and transverse nervures, forming cells which are more irregular at the base in the male than in the female, and this is almost the only external sexual difference, for the female has no ovipositor. Wings two, ample, membraneous, triangular, folded longitudinally, lying upon the back when at rest, and extending beyond the abdomen; they are dirty white, with an iridescent lustre, rayed like a fan with ochreous nervures and numerous transverse white ones; the costa is brown, as well as a stripe below it: the abdomen is twice as long as the thorax, very thick, soft, and cylindrical, composed of nine or ten rings; on each side of the apex is a hairy filament like a rat's tail, as long as the antennæ, but stouter. Legs six, very strong, especially the anterior, which are compressed and dilated; the hinder pair are formed for leaping; anterior thighs short and broad, with a sharp semi-ovate tooth inside at the base; hinder pair long and incrassated; shanks of fore-legs trigonate, palmated, the apex being cut into four very strong spreading teeth; posterior long and spiny outside and at the apex: feet triarticulate, anterior compressed and trigonate, attached to the outside of the tibia, basal joint large, and with the second forming two horny acute teeth, third small and ovate, terminated by two straight unequal claws; in the other feet the first and third joints are elongated, and the second is very short; the claws are curved and sharp.

In June, or at the commencement of summer, the female constructs in the vicinity of her burrows a nest half a foot deep in the earth; it is two inches long and one deep, formed like an oval bottle, with a curved neck which communicates with the surface, and the inside surface is smoothed for the reception of the eggs, which amount to 300 or 400, and after they are deposited the female accurately closes the entrance. These eggs are about the size of turnip-seeds, but oval, shining, and brownish-yellow: fig. 2. The young hatch in July and August, or about a month after the eggs are laid: they immediately begin to feed upon the tender roots of the surrounding plants, whether corn, grass, or vegetables, and when these fail, then they go further in search of food; but subsequently to their first moult, which takes place a month after they emerge from the egg, the family disperses.

When the mole-crickets first hatch, they look very much like black ants, and are not more than ⅛ of an inch long (fig. 3; fig. 4 after the first moult); at this period they have no wings, they go on growing and moulting until they are 1½ inch long, when rudiments of the wing-cases appear, and in this pupa state they remain feeding and increasing in bulk until the fifth or last skin is cast off, and the perfect winged insect is developed and fit to propagate the species. This metamorphosis takes place at the close of spring; they live through the summer, pairing and laying eggs, and pass the winter in the earth, burying themselves deeper as the cold and frost affect them; there protected they remain from October or November until the warm days of March again invite them to the surface, when they may be traced by the heaps of earth they throw up like little mole-hills; at other periods their presence may be detected by their operations, for yellow withered patches deface the pastures, and similar decay is indicated amongst the garden vegetables. Great doubts have been entertained as to their chirping, but Latreille states that after sunset they make a noise strong and shrill enough, which is said to be caused by the friction of the nervures of one wing-case over the other; and we learn from Mr. R. H. Lewis that the mole-cricket is a very noisy insect in Van Diemen's Land. This song or call, like that of the crickets, is produced by the males to invite the females from their burrows, to prepare for the peopling of new colonies.

So great a pest are these insects, that there is no want of remedies or modes of extirpating them, which I will now proceed to discuss, and as they have been suggested and tried by first-rate cultivators, they cannot fail to be serviceable to those who may be so unfortunate as to suffer from the inroads of the mole-cricket. I must, however, not omit to observe that some naturalists have an idea that this animal is even beneficial, from its carnivorous habits, but it is scarcely possible that so many experienced gardeners should have unhesitatingly stigmatized this insect in various countries for at least a century, if it did not deserve the bad character it has obtained. What will those, who maintain an opinion that mole-crickets are beneficial, say to Mr. Brackenridge's unqualified statement, that "it is the greatest enemy the gardener has to contend with at Berlin, where it appears about the beginning of summer in myriads: nothing in the herbaceous way is proof against its ravages;" and he adds, "I have seen the stem of a dahlia an inch thick cut through by it in the course of a night, with as much precision as if done with a knife."* It is true that Dr. Kidd, in his admirable *Memoir* upon this subject, says that mole-crickets prefer raw meat, and will attack each other, when the victor devours the flesh of the vanquished; but that they can live nine or ten months without food.† Bouché gives similar evidence of their ferocious disposition when he states that "luckily the mother devours a great number of her offspring, so that out of a hundred not more than eight or ten survive." ‡ I can also bear testimony to their carnivorous habits, for one that I kept alive with grass turves in the cage, fed upon the caterpillars of the lackey-moth, § with which I supplied it for some time, and it is reported to devour worms and subterranean larvæ: this, however, only shows that the mole-cricket is omnivorous.

It has been stated that mole-crickets may be enticed under a glass or pot, by using some odoriferous composition, in the same way as rats are taken; and Scopoli, an Austrian naturalist, maintains that they are attracted by horse-dung, and driven away by that of pigs, the warmth arising from the former probably suiting their economy. Mr. A. M'Barnet found that lamp-oil destroys them very readily, and soap suds also will kill them, but not so speedily. He is of opinion that the refuse of soap-manufactories or any greasy manure might be serviceable, and also soot, lime, and like substances.‖ A simple plan of pouring water into their burrows first, and then a few drops of oil, which killed the insects by stopping their respiration probably, was actually purchased by Louis XV. By burying small garden-pots, into which about thirty drops of oil of turpentine must be previously poured, and covering them over with boards to keep out the earth, the mole-crickets may be driven from their quarters, and the vapour will kill those that are near it; for their scent is so acute that it is said if a dead crab be introduced into their burrows, the effluvia will destroy them. M. Robert, of Toulon, places fresh turves on the borders where traces of the mole-crickets are observed; they are watered every night, and the insects secrete themselves beneath, and are easily caught in the morning.¶ By persisting in this method, especially in April, May, and June, an infested place will soon be freed from them; this seems to be a good and available plan, especially in dry seasons, for Mr.

* *Gardeners' Magazine*, vol. xii. p. 300.

† See *Philosophical Transactions*.

‡ Bouché, *Naturgeschichte der Garten Insecten*, p. 35.

§ *Clisiocampa neustria*. Curtis's *British Ento.*, fol. 229, and *Gardeners' Chronicle*, vol. iii. p. 244.

‖ *Trans. Entomological Society*, vol. ii. p. xi.

¶ *Annales de la Soc. Hor. de Paris*.

Brackenridge says, "From the circumstance of these insects seldom appearing on the surface, and the rapidity with which they breed, no method has been fallen upon whereby they are likely to be eradicated, although hundreds of thousands are caught yearly by means of flower-pots plunged with their brims about two inches below the level of the surface, into which the insects fall during their nightly rambles."* In June and July the eggs may be destroyed in hundreds, by digging up the nest of the mole-cricket, which an experienced gardener discovers with little trouble by tracing their winding burrows; or boiling water poured over affected parts in meadows will kill them, and urine or salt and water might be used advantageously.

However useful these suggestions may be, especially to the gardener, the following plan, recommended by Köllar, is the one to be adopted by the farmer on a larger scale. When there is a flat area of 500 or 600 yards, dig three or four pits in September, two or three feet deep and a foot wide; then fill them with horse-dung and cover them over with the earth: attracted by the warmth, all the mole-crickets will resort to these pits from the surrounding neighbourhood on the first frost, and may then be easily destroyed.†

Secure in their subterranean habitations from insect parasites to reduce their numbers, what a singular provision is made to keep the mole-crickets in check, namely, the destruction of the young by their parent, to the amount of ninety per cent. and upwards, otherwise they would, first, cause such destruction to the various crops that famine must ensue, and next, the species would become extinct, for want of food for the young broods. The services, also, of the poor persecuted mole are most essential in acting upon the masses of the insect race, and especially upon the formidable hordes of the insect which partakes of its habits, and from which it receives its name. Bouché says, "This little quadruped, called by Linnæus *Talpa europœa*, is continually digging in pursuit of insect larvæ, particularly grubs, mole-crickets, and earth-worms, and destroys them. I have observed (he says) that a field which contained an endless number of root-worms or mole-crickets, was freed entirely by the moles in two years. They certainly destroy many young plants by burrowing, but their usefulness is found to overbalance by far the mischief they occasion, which is only when the plants are young. They likewise retire from those places where they find no prey to be caught, when they have freed the field from vermin. It is therefore not wise entirely to destroy the moles. At any rate, their numbers may be lessened in flower-gardens and meadows; yet even there they ought not to

* Mr. Brackenridge's observations were published some years before M. Robert's plan was promulgated.

† Köllar's *Naturgeschichte der Schädlichen Insecten*, p. 154, and Loudon's *Translation*, p. 147.

be extirpated, for the mole, with regard to the destruction of insects, may be regarded under ground in the same capacity as the sparrow is above ground.* Hoopoes, crows, and choughs eat many more.'

SUMMARY OF THE FOREGOING CHAPTER.

Pea crops subject to *mildew.*

The *early* ones destroyed by *millipedes* in cold and wet seasons.

Weevils, named *Curculio lineatus,* eat off the crops and notch the leaves, and likewise *broad-beans.*

They first *appear* in *March,* and are most destructive in *April.*

In the year 1844 they were universally distributed, and *ate* off the *second and third sowing.*

Feeding in March from nine or ten in the *morning* for the rest of the day, and *hiding* under clods at *night.*

They stand *feeding* on the edges of the *leaves,* and *fall down* as if dead when *approached.*

Marrowfat and *early pease* suffer *most, hog-pease* the *least,* from their attacks.

These *weevils* attack the *pease* first, then the *beans,* and lastly the *clover* and lucern.

Entire fields of *lucern destroyed* by them after *sowing two and three times.*

A field of *lucern* sown in *July* escaped their ravages.

In *September,* 1841, they *ate off* more than half an acre of *clover,* at the headland of a barley lay, and continued their operations in *October.*

Where the *eggs* are *laid,* or on what the *larvæ* of the weevils *feed,* is *not known.*

The *beetles* inhabit the *broom* and *furze flowers* early in the spring.

Do the *galls* on the *roots of beans* contain the maggots of these weevils?

Another weevil, called *Curculio crinita,* attacks *pea-crops* in the same way.

Three hundred feet at Brecon more or less *destroyed* by this species, as well as a *crop* in *Norfolk.*

Certain seasons favour, others *check* their *multiplication.*

Destroying crops where pease had *never failed* for seven years.

Shaking the pease over *tarred* or *painted* strips of *canvas* a good *remedy* in the garden.

Although *soot, wood-ashes,* and lime, will not destroy the weevils, they render the *leaves unpalatable,* when dusted over them.

* *Naturges. der Garten Insecten,* p. 165.

Leaving *a row* of pease *undusted*, will prove *a good decoy*, when they may be destroyed by hot water.

Harrowing and hoeing recommended for field-crops whilst the dew is upon the plants.

Little *maggots* of a fly called *Phytomyza nigricornis* mining in the *pea-leaves.*

In wet seasons minute *maggots* live *inside* of *diseased pods.*

Pease when matured *worm-eaten* by the *caterpillar* of a *moth* named *Grapholitha Pisana.*

These *larvæ buried themselves* in July and August, and changed to pupæ in fine webs.

Are not the *eggs laid* upon the *blossoms* or *young pods* in the spring?

Humble-bees render *beans abortive* by drilling a hole at the base of the flower into the embryo pod.

Scarlet-beans and various *flowers destroyed by them* in the same way, the latter to such an extent that not a single flower in some beds could be found that was not punctured.

Whether the *bees* resort to this mode of getting at the honey to *save trouble*, or from the *flowers being too small* to admit of their entrance, is doubtful.

Beans spotted, *distorted* and *unprolific*, from the punctured flowers.

Two species of *humble-bees* detected in the act, namely, *Bombus terrestris* and *B. lucorum.*

They form their *nests* in *old loose walls*, at roots of trees, &c.; *live through the winter*, and resort to the *willows* when in flower.

Butcher-birds bestroy *humble-bees*, and the *maggots* of a fly called *Volucella inanis*, as well as the *caterpillars* of a moth named *Ilythia colonella*, live upon the larvæ of the bees and consume their honey.

Pease smothered with *Aphides*, called lice or *Green dolphin.*

Beans infested with *Aphides*, known as the *Black dolphin* or collier.

In 1833 the *bean crops* were nearly *destroyed* by them in Yorkshire.

The *first week* in June they were all *apterous*, in the *second week winged* specimens appeared.

Beans should be *topped* on their first appearance, and the *tops* collected and *burned.*

The *Black dolphin* also infests *scarlet* and *French beans* as late as *October.*

They *exhaust* the plants by imbibing the *sap.*

The larvæ of *lady-birds*, the maggots of *flies*, and of minute *Ichneumons*, destroy the *plant-lice.*

Pease and *beans* attacked by beetles called *Bruchus,* and "Bugs" by the farmers.

These *beetles* are nearly confined to the seeds of leguminous or *pod-bearing plants.*

Bruchus pisi, a native of *North America,* introduced into the *South of Europe,* and frequently found in imported pease.

Owing to the *ravages* of this insect in the *United States,* the *culture* of this crop was altogether *abandoned.*

The female deposits an *egg* in almost *every pea* when the plants are in *bloom.*

The *maggot* feeds in the *pea* during the *winter* and part of the *summer.*

The *beetles* are *hatched* in the *spring,* sometimes in the *autumn,* when they force their way out of the cell through the skin of the pea, which had been previously cut by the maggot.

They are often found *dead* in the *pease* and *beans.*

Bruchus granarius is the species *infesting* our *own crops,* and *imported* with seed *annually.*

It appeared on some *beans* grown from inoculated *foreign seed.*

It is abundant on the *furze* when in *flower,* and many other plants.

The *maggots* sometimes *destroy* more than *half the crop* in parts of *Kent.*

They *swarm* in *May,* and are found in *August* and probably later, for one imported with Russian beans was *alive* in *November.*

Pease and every variety of garden and field *beans* are subject to their *attacks.*

Infested *beans* often exhibit *no external signs* of the presence of the *Bruchus* to the *uninitiated.*

The *maggots* do *not* generally *destroy* the *germ,* so that the *seeds* will *vegetate.*

By *sowing inoculated seed* the *insects* are introduced and *propagated.*

Seed should be *examined before sowing,* and the *infested beans* may be detected by *dull circular spots* on the skins where no holes are to be found.

Minute *brown dots* on the beans, made by the *young larvæ,* or by parasitic *Ichneumons.*

People poisoned in France by eating *worm-eaten pease* containing the maggots and beetles of *Bruchus pisi.*

Sicilian beans, containing the *Bruchus flavimanus,* affecting the *health of horses* which fed upon them.

Some *beans contained two or three beetles,* which were *alive* in *December.*

They *appeared sound,* being nearly free from holes in the skin.

Three species of *parasitic flies* have been discovered, whose *larvæ feed* upon those of the *Bruchi*, namely, *Sigalphus pallipes*, *S. thoracicus*, and *Chremylus rubiginosus*.

Chalky districts seem to be *favourable* to the increase of the *Bruchus granarius*, from the soil probably producing wild flowers which supply the beetles with food.

Late-sown pease and *beans* most likely to *suffer* from the *Bruchi*.

Pease, if *kept over* the *year*, are *free* from this pest, from the *beetles* having *deserted* them.

Many of these *insect plagues* introduced with *foreign seed*, owing to their being grown in warmer countries, where *noxious species* are *more abundant* than with us.

To *destroy* the *maggots* in the *pease* without injuring their vitality, *immerse* the *seeds* in *boiling water* for *one minute*.

An immersion of *four minutes* in boiling water *will kill* nearly all the *pease*.

Kiln-drying at a heat of from 133° to 144° will *kill* the *insects* without altering the quality of the pulse, but such seed will no longer vegetate.

To *split the pease* and deprive them of the husks will *preserve* the *winter stores* from further injury of the *Bruchi*.

Immersion in *oil* would probably *kill* the *insects*.

Maggots of a little moth called *Tinea sarcitella* infesting *worm-eaten pease*, and *matting* the *sacks* together.

This is especially the case when *pease* and *beans* are *stored* in a *damp* condition.

These *moths* will *breed* in *drawers* where seed is put away for use.

They were *breeding* freely amongst the *dead roots* of some *barley* in a box.

They inhabit our *houses* and *gardens*, injuring all *woollen goods*.

The *eggs* are laid in preference upon *clothes*, *blankets*, *carpets*, &c., upon which the active wriggling *larvæ feed*, forming cases of the eaten materials, in which they undergo their transformations.

The *maggots* of a parasitic fly, called *Bracon variegator*, live upon the *larvæ* of the *Tinea*.

It is essential to *ventilate pea and bean stores*, to keep them dry and secure from these insects.

Empty sacks should be well *exposed* to the *sun* or *kiln-dried*, as opportunities offer.

Sacks should be entirely made of *hemp* or vegetable fibre, and never *mended* with worsted or patched with *woollen*.

Fumigating with *sulphur* or evaporating spirits of *turpentine* will *destroy* these *insects*.

Dusting the seeds with *pepper,* or inclosing *camphor* with them, will *banish* the insects.

The *mole-crickets* a dreadful scourge in *corn-fields, meadows,* and *gardens.*

They are at present most *destructive* in *Germany* and *the South of France,* but are gradually *extending* their *northern bounds.*

In many parts of *England* they *abound.*

In Germany one-sixth and even one-fourth of *young corn-crops* fall a sacrifice to the *mole-cricket;* they also attack *pease* and *beans.*

Most destructive in the *Botanic Garden* at *Berlin,* and destroying the *sugar-cane* in the *West Indies.*

It *burrows* under ground, living like a *mole* in miniature, and only comes forth in the evening and at night.

Mole-crickets have been supposed to emit the dancing light called the "*Will-o'-the-wisp.*" They *sing* or chirp in the *evening.*

The *female* constructs an *oval cell* in the earth in summer, to deposit her *eggs* in, amounting to 300 or 400.

The *young* hatch in about a month, look like *black ants,* live in *society,* feeding upon the roots at hand, until they cast off their first skin, when they *disperse.*

When *young* they have *no wings,* but attain *rudiments* of them as they increase in size, and after the fifth moult they are furnished with *ample wings.*

They pass the *winter* in the *earth,* and come forth in the *spring,* when they may be traced by their little *hillocks.*

Where they live the *grass* and *vegetables* become yellow, and *wither.*

They are *omnivorous,* feeding upon *animal* as well as *vegetable* substances, yet they can live nine or ten months *without food.*

They *fight,* and devour each other, and the *female eats* nine-tenths of her *offspring.*

They may be *enticed* into *traps* by certain *odours.*

Horse-dung is said to *attract,* and *pigs'-dung* to *drive them away.*

Oil and *soap-suds* will *kill* them. *Greasy manures,* soot, and lime, would assist in *banishing* them.

Water poured into their burrows with a few drops of *oil* will *destroy them.*

Garden-pots buried in their runs, with thirty drops of *oil of turpentine* in each, and covered over with boards, are *excellent traps.*

Fresh turves watered every night will *decoy* them to retreat under them.

Hundreds of thousands are *caught* at Berlin annually, by sinking *flower-pots* two inches below the surface.

In June and July the *eggs* are easily *destroyed* by *digging* up the *nests*.

Boiling-water, *urine*, and *salt and water*, may be poured over *infested spots*.

Farmers are recommended to *dig pits* in September, two or three feet deep and a foot wide, *fill* them with *horse-dung*, and cover over with earth; on the first appearance of *frost* all the mole-crickets in the field will *resort* to these *traps*.

Their *increase* would be so *prodigious* were it not for the extraordinary *habits* of the *females*, that *famine* must ensue where they took up their abode.

Moles most serviceable in hunting and *destroying* them: it is *unwise* to *extirpate* that little quadruped.

Crows and various strong-billed birds *devour* large numbers.

Explanation of Plate L.

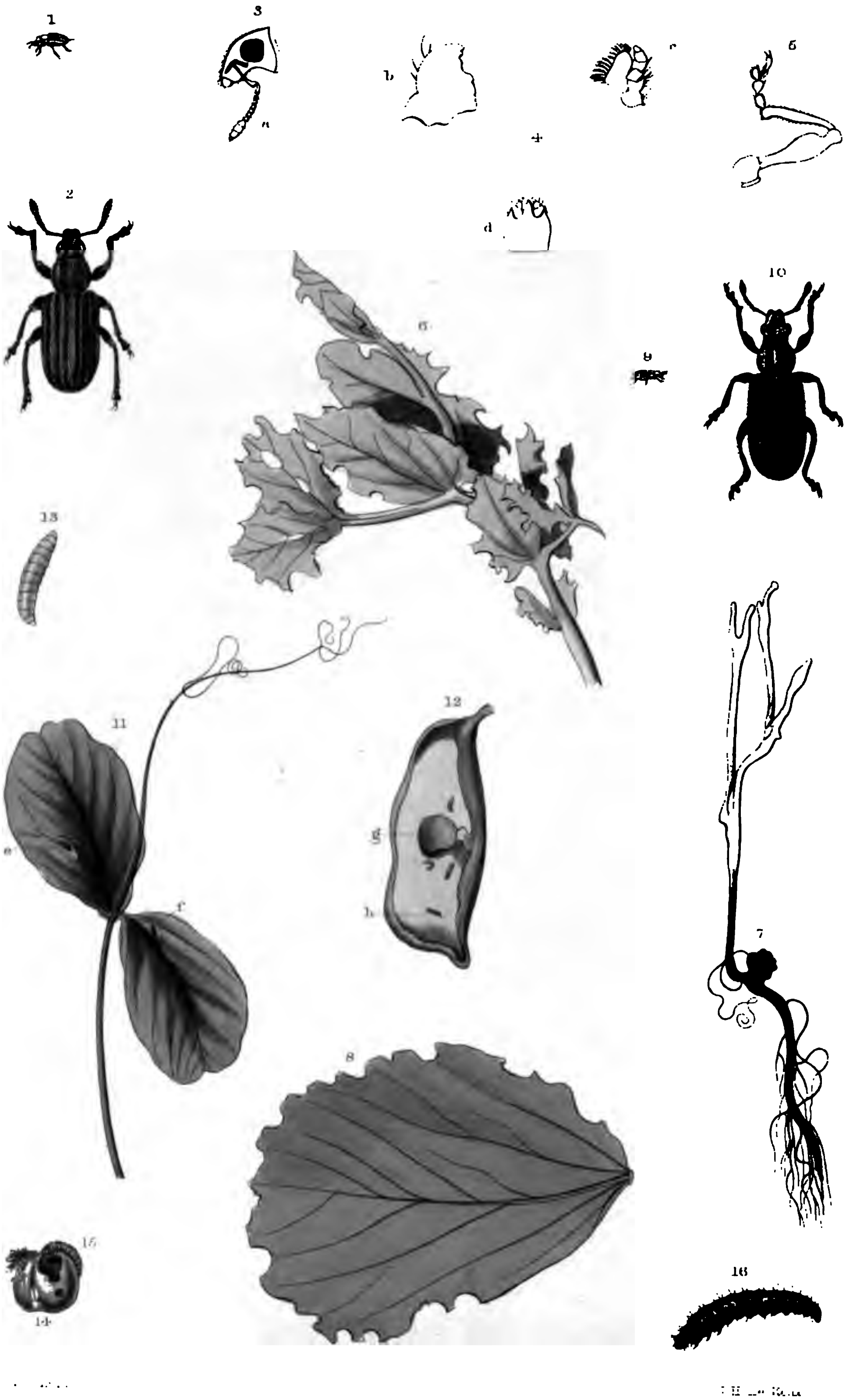
Fig. 1. *Curculio* or *Sitona lineata* walking.
Fig. 2.* The same magnified.
Fig. 3.* The head in profile.
  a, The antenna or horn.
Fig. 4.* Organs of the mouth.
  b, The mandible.
  c, The maxilla or jaw, and palpus or feeler.
  d, The under lip and labial palpi.
Fig. 5.* The fore-leg.
Fig. 6. A pea-plant notched and perforated by the *Curculio* or Weevils.
Fig. 7. Another pea-plant entirely defoliated by them.
Fig. 8. A bean leaf notched by the same *Curculio*.
Fig. 9. *Curculio* or *Sitona crinita* walking.
Fig. 10.* The same species magnified.
Fig. 11. The extremity of a pea-plant.
  e and *f*, Pupæ of mining larvæ of *Phytomyza nigricornis*.
Fig. 12. A diseased pea-pod opened.
  g, The shrivelled pea.
  h, Maggots of a minute fly.
Fig. 13.* The same magnified.
Fig. 14. A worm-eaten pea.
Fig. 15. The caterpillar of a moth.
  i, The excrement.
Fig. 16.* The caterpillar magnified.

The numbers with a * attached refer to the objects which are represented larger than life. All the figures are drawn from nature.

PEAS AND BEANS.

PLATE I.

Maggots and Weevils feeding on Peas and Beans.



CHAPTER XIII.

THE NATURAL HISTORY AND ECONOMY OF A WEEVIL AFFECTING THE PEA CROPS, AND VARIOUS INSECTS WHICH INJURE OR DESTROY THE MANGEL-WURZEL AND BEET.

CURCULIO (OTIORHYNCHUS) PICIPES—*the Pitchy-legged Weevil.*

IN the last chapter the history of two weevils was detailed which cause great mischief to the early pea crops, and attack the broad-beans also: I now find that another species assists very materially in the destruction of these plants.

In the midsummer of 1847, Mr. George Gill sent me many specimens of a beetle alive, and informed me "that they were making sad havoc in the vicinity of Kettering, in Northamptonshire, amongst several different plants, more particularly pease, turnips, and young winter-plants, as savoy, kale, broccoli, &c." A market gardener in the same neighbourhood had four rows of pease, seventy yards long, destroyed by them, and the general crop much injured. About eight poles of white turnips, just fit for the hoe, were eaten off in two nights, and the same quantity of winter-greens, nearly in a state for setting out, was also devoured.

During the day Mr. Gill observed the weevils remained in clusters under the soil, but as soon as the sun was set they came out and commenced their depredations, which they continued until four o'clock in the morning, when they again retired for the day. It is possible the caterpillars of *Noctua segetum* and *N. exclamationis*, called surface-grubs, (described and figured in chapter v.), might assist in the destruction of the turnips and winter-greens; but no doubt Mr. Gill is correct regarding the pease, for on putting four of the weevils into a box with some shoots of pease and horse-beans, in two nights they ate the holes in the stem and leaves as exhibited in the plate (Plate M, fig. 1), as well as others in different parts of the plants.

This weevil is sometimes a dreadful pest in gardens, committing sad ravages on vines in hot-houses and on wall-fruit during the night, when they emerge from their hiding-places in old walls, from under the bark and clods of earth, to revel upon the branches of the new wood in April, or to feed upon the young shoots, which soon become black. They likewise injure raspberry plants in spring by eating through the flowering stems and leaves, and they nibble off the bark, and eat out the buds of apple and pear trees as early as February or March.*

The larvæ also (fig. 7; 8, the same magnified) are very destructive to the roots of flowers and various plants in the autumn, winter, and spring, when they change to pupæ (fig. 9; 10, the same magnified), in which state they remain probably not more than a fortnight.

The larvæ or maggots are fat, whitish, and wrinkled, with horny hazel-coloured heads: they lie generally in a curved position, and having no feet, remain feeding under ground, pretty nearly in the same spot where they were hatched. Having arrived at their full growth, they form an earthen cell, and change to a torpid pupa of a whitish colour, with black eyes, exhibiting through the skin the limbs, folded up, of the future beetle. The horns, rostrum, and legs are compactly arranged, and the small wing-cases are wrapped round the sides, exposing the body. From this pupa issues the beetle or weevil, which is included in the order COLEOPTERA, the family CURCULIONIDÆ, and the genus OTIORHYNCHUS or CURCULIO, and is described by Fabricius as—

1. *C. picipes;* but Marsham gave it the name of *Curculio vastator*, from its destructive habits. It is of a clay brown colour, and so exactly partakes of the complexion of the soil, that when it remains at rest or with the limbs contracted, as it falls down when disturbed, it is scarcely possible for the eye to discern the creature. The horny covering is curiously tuberculated, and sprinkled over with minute scales, more or less inclining to white, yellow, or coppery. The head is produced into a short stout rostrum, which is dilated at the apex by two cavities like nostrils, in which the horns are inserted: these are chestnut brown, hairy, and twelve-jointed; the basal joint is long, and forms an angle with the remainder; the second is short and oval; third twice as long; five following globose; the rest forming an ovate-conic club: the eyes are lateral, black, and orbicular: at the extremity of the rostrum is placed the mouth, which is composed of five distinct pieces: the two mandibles or jaws (fig. 4) are horny and strong, terminating in a pointed tooth, with a smaller one inside: the maxillæ, or second pair of jaws (fig. 5) are also strong, with a spiny lobe, and a bunch of long hairs beneath, with a triarticulate palpus or feeler on the outside (fig. *c*); the mentum or chin (fig. 6) is oval, concealing the lip and producing two minute biarticulate palpi or feelers (*d*); the thorax or trunk is subglobose, and twice as broad as

* *Gardeners' Chronicle*, 1841, page 292.

the head; the wing-cases are soldered together; they are very convex, oval, and clouded, with twenty rows of pale dots formed by scales; wings none; legs six, strong and hairy; thighs stout, notched beneath; tibiæ or shanks flexuose, dilated at the apex and pectinated; feet four-jointed—two basal joints reverse—trigonate; third, bilobed; fourth, clavate, terminated by two minute claws; fig. 2, the weevil reposing; fig. 3, the same walking, but magnified.

From the great variety of trees and vegetables on which these weevils will subsist, it seems scarcely possible to guard against their inroads. As they are unable to fly, when they attack the pea crops no doubt they sally forth from the hedge-rows, which frequently swarm with these beetles, for I have found them in multitudes, feeding on black-thorns, elms, lime-trees, &c., in May. A dressing of salt or gas-lime would, I expect, destroy the larvæ, as either of these substances will kill the maggots of nuts; but we seldom know where they are deposited at this stage of their existence, and the beetles are safer in their horny coats than a tortoise in his shell: nothing but boiling water or spirits of turpentine seems even to annoy them. It is difficult, therefore, to apply any remedy except hand-picking. The crops in nurseries have been preserved by men going out at night and drawing the branches through their hands, and putting the weevils into large-mouthed bottles, as well as by shaking the branches over sieves, which were emptied into pails of water. The beetles are, however, so timid and wary, that they are most successfully collected without lanterns; and if lights be used, the infested plants must be very cautiously approached, otherwise the weevils will fall down and escape. Possibly by dusting with soot, lime, or wood-ashes, and watering with gas-water, the ground might be made disagreeable to them; and rows of young pease might be, in a measure, protected by boards, three or four inches high, set on each side, and sloping outward. As soon as the pease make their appearance above ground the boards should be tarred on both sides, so that the beetles could not surmount them, and many of those inclosed between the boards would, no doubt, be caught by the adhesive tar.

We are, however, indebted to a genus of sand-wasps for reducing the numbers of these pests, which could not otherwise be kept in check. Their services are unceasing and invaluable—and it is a law of nature that as the insect-plague spreads, the parasites that prey upon them increase in an equal or greater degree, until the mischief is subdued. Some of these sand-wasps often appear in vast numbers, especially in gravelly ground and sandy banks, where they form burrows to lay their eggs and rear their young, and for this purpose some species fly abroad in search of a group of wild bees called

Andrena,* whilst others are engaged in collecting the weevils, which they bury in their subterranean nests, to feed their young maggots as soon as the eggs hatch. In the gravel walk of a garden at Boulogne-sur-Mer, in August, there were innumerable holes made by these sand-wasps, and the females were busily occupied in carrying home a species of weevil closely allied to the *Otiorhynchus picipes*, and described under the name of *O. scabrosus*. On digging about a foot deep I found several of the beetles which had been thus buried, the contents of whose bodies had been completely emptied out, and nothing was left but the horny shells.† *O. sulcatus* is another species they have been detected carrying alive between their legs; and a different genus of weevils, called *Strophosomus*,‡ has been recorded as falling a prey to them.

These sand-wasps are of the order HYMENOPTERA, family CERCERIDÆ, and genus CERCERIS. The species which buries the weevils is named by Linnæus—

2. *C. arenaria*, but it is the *C. læta* of Fabricius. The *female* (fig. 11) is black, thickly punctured and pubescent; the head is large, armed with strong jaws, &c.;§ the larger eyes are long, vertical, and lateral; behind them is a yellow spot, and inside, on the face, is a patch, a small spot, and between them an oval one on the nose, all yellow; on the crown are three minute eyes called ocelli, forming a triangle; the short curved horns are inserted in front of the face, and are twelve-jointed in the females; they are rusty beneath at the base, the first joint being the longest and stoutest; second, globose; third, slender and longer than the following, which are a little oblong, the terminal joint ovate; thorax convex, oval; two yellow spots on the collar, a transverse one behind the scutellum, and an oval one on each side of the metathorax; scapulars yellow also: abdomen long and elliptical, attached by a narrow base; the segments contracted at their union; six-jointed; first joint small, pear-shaped, with a yellow lunate spot on each side; second, large, cup-shaped, yellow, with a black triangular space at the base, two following with narrower yellow margins, fifth with the yellow margin broader; apex with two elevated lines, forming an ellipsis: wings four, tinted with brown, especially at their tips; superior ample, with a small rusty stigma; one marginal and four submarginal cells, the second attached by a short nervure; legs six, strong, orange-coloured; trochanters black, as well as the base of the four anterior thighs; shanks spiny outside, spurred at the apex; feet five-jointed, ciliated, with spiny appendages outside, and terminated by two claws and pulvilli.—*Male* smaller, face more

* Curtis's *British Entomology*, fol. and Plate 129. † Ibid. fol. 690.

‡ Curtis's *Guide*, Genus 374[b]; and Shuckard's *Fossorial Hymenoptera*, page 235.

§ Curtis's *British Entomology*, Plate 269, for the dissections, &c.

yellow, with a yellow patch under the basal joint of the antennæ, which are thirteen-jointed; yellow marks of the trunks smaller, the two spots on the metathorax wanting, and those on the basal segment of the abdomen are only minute dots; there are seven segments with five yellow bands, more equal than in the female; the thighs are blacker, and the hinder pair are black also, excepting the base; the hinder tibiæ are likewise blackish at their extremity, and the fore feet are not ciliated with spines.

"Economic Entomology," or a knowledge of those insects which injure cultivated crops, is so vast a field of discovery, that every season brings forth fresh subjects for investigation; and although this arises in a great measure from the neglect which has attended this important department of natural history, it seems as if a cycle were revolving, which exhibits species previously unobserved, at intervals of greater or less extent; and whether regular or irregular cannot be determined for want of data: rare and unnoticed species, no doubt, become abundant or scarce by changes of temperature; certain and continued currents of air, a want of food in their accustomed localities, and similar phenomena, may also change the regular course and geographical distribution of insects for a season; so that enemies to the cultivator may suddenly become great annoyances in latitudes where they had been previously unknown; and may there remain until a counter-action takes place, either of climate or by parasitic agency, which at once sweeps away the plagues and releases us from those great armies which are employed by the Power who created them. These are profound and mysterious subjects which we cannot fathom, yet the divine book of nature is open to all; but it will only prove profitable to those who have a thirst for knowledge, and who delight in contemplating the wonderful works of the Creator.

During the summer of 1847 the prodigious swarms of *Aphides** which suddenly covered the young shoots and under sides of the leaves of almost every plant, so that the surface was blackened by them, was unprecedented, as far as can be ascertained, and it excited the attention of the public generally. The migratory locust, which is an awful visitation on the Continent,† also reached our island the same year. I had several transmitted to me from various counties; and during a short stay on the eastern coast in August, I saw six specimens which had been captured in a wheat field by the gleaners, yet neither the aphides nor the locusts were observed the following year; indeed, the former died in closely packed groups, with their beaks thrust into

* From a careful examination of these insects, I consider them to be identical with the bean-plant louse, *Aphis fabæ;* and Mr. Francis Walker entertains the same opinion. See chap. xii. No. 52, figs. 1 and 2.

† See Kirby and Spence's *Introd. to Entomology*, sixth edit., vol. i. p. 185, and seventh edit., p. 125.

the leaves, and their wings erect; and possibly were either poisoned by feeding upon juices not adapted to their constitutions, or they might have been held fast by the drying of the leaves in which their rostrums were imbedded. A still more remarkable instance of the sudden appearance of insects, and the destruction of crops hitherto free from such depredations, we shall give in the development of the economy of those species which affect the mangel-wurzel.

SILPHA OPACA—*the Beet Carrion-beetle.*

Dickson* says, that mangel-wurzel is not injured by insects or drought; and such appeared to be the case until about 1844; when in France and Ireland the larva of a beetle made its appearance in sufficient numbers to carry off entire crops, and I find it now has several insect enemies to contend with.

There is a carrion-beetle called *Silpha opaca,* which was known to Linnæus, and is common enough in dead animals in April: it has also been found in February at the roots of trees, where probably it had wintered. In May I have detected it under stones in sandy warrens, and also on the flowers of the mountain-ash; it seems therefore probable that it will live upon caterpillars; and Dr. Calvert, some years since, sent me specimens he had found in his wheat fields in Yorkshire, which he suspected injured the corn. The most remarkable trait in the economy of this insect is, that its larva will feed upon the leaves of the mangel-wurzel, for it had always been considered to live, like its parent the beetle, upon putrid animal substances. Mr. Haliday, however, has found a few larvæ of a *Silpha* at the roots of artichokes in Ireland, and they are also abundant under marine rejectamenta there; it is therefore possible that they feed upon sea-weeds and any succulent or gelatinous vegetables which approach animal substances in texture and fleshiness: but here again, if such be the case, is a considerable difference in the habits of the insects; because the larvæ hitherto known, only live upon *putrid* animals, such as dead birds, rabbits, hares, hedgehogs, &c., whereas those I am about to describe feed upon the *fresh*-expanding leaves of the mangel-wurzel, fig. 12.

In June, 1844, my attention was first called to this subject by W. Ogilby, Esq., who sent me specimens of the larvæ, forwarded to him by the Rev. Edward Bowen; and he informed me that they had eaten off all the mangel-wurzel on the farm of John Ferguson, Esq., of Castle Forward, Londonderry. Nothing further occurred until I received a communication from the Rev. C.

* *Practical Agriculture,* vol. ii. page 723.

Maxwell, of Birdstown, Londonderry, dated 31st May, 1846, with one of the larvæ, and stating that his mangel-wurzel was being devoured by this animal; and, on June the 9th, he added that every plant had been annihilated. The field had been entirely dressed with common farm-yard manure: on the 23d of April, about half a rood of carrots and the same of parsnips were sown; next in order an acre of mangel-wurzel, then Swedish turnips; and, on the 1st of May, beet-root. Every crop promised to succeed, except the mangel-wurzel, which was destroyed by the larvæ alluded to. They were to be seen in large quantities in the mangel-wurzel ground, but none in that portion of the field under other crops. Subsequently, however, the beet-root was assailed by the same insects: it seems the crop was attacked almost as soon as it appeared above ground, viz., about the 21st of May, and the larvæ disappeared at midsummer, for only two could be found on the 24th of June; they were then in the pupa state, or might be starved for want of food. It is the leaves they devour, leaving only the fibres. In 1847, Mr. Maxwell says, in a letter dated June the 12th, "This destructive animal has again visited the same crop this season, at the same time of the year, and under similar circumstances; but in greater numbers and with increased injury to the crop." The specimens transmitted are smaller in size than those sent last year: not yet, I presume, having attained their full growth. "The crop is so totally destroyed, that it is of no use attempting any method to remove the insects by lime or otherwise; but it would be very satisfactory to ascertain their origin, and by judicious measures to prevent their re-appearance at a future time. The mangel-wurzel is the only crop attacked in a field sown with potatoes, turnips, pease, and beans." With the larvæ were inclosed some of the leaves which were amongst the least injured, the greater part of the plants having been completely eaten down to the root.

I learned, by a subsequent communication from Mr. Ogilby, that the depredations of these larvæ were not confined to Londonderry, for they made their appearance the same year upon his property in the next county of Tyrone. He says, "A much larger breadth of root crops of all kinds, including mangel-wurzel, was put down last year by my tenants than during any former season; partly owing to the failure of the potato crop, and partly to the offer of very large premiums on my part. Turnips, parsnips, carrots, and cabbages have succeeded admirably; but of the mangel-wurzel the whole crop was cut off by the insects, before the cotyledon leaves had well penetrated to the surface—as soon as ever they appeared the plants were attacked, and I may almost say that they were never seen, so rapid was their destruction. One crop, and, as far as I am aware, one alone in my neighbourhood, that of the Rev. Mr. Brownlow, of Alla, succeeded—or, I should rather say, escaped."

In manuring Mr. Maxwell's field, no bones or offal, beyond what might have been accidentally thrown on a dunghill, had been used. This was in answer to my supposition that these larvæ had been introduced into the mangel-wurzel fields with the manure, either bones or sea-weed; such did not appear to be the case; but with the few facts we have at present collected relative to this new pest, attention must be given to every collateral bearing. It seemed desirable to report Mr. Maxwell's observations as fully as possible, in order that the subject may be carefully investigated, lest the cultivation of this valuable crop should be abandoned in Ireland; and it is very remarkable that although the insect is abundant in England, I have not heard an intimation of its appearance upon the mangel-wurzel. Indeed, at present, it is unknown on this side of the water as an enemy to the agriculturist.

It is not so, however, in France; for we learn from M. Guérin Méneville,* who is indefatigable in the pursuit of every branch of entomology, and has lately devoted himself to investigating the economy of the insects affecting the various crops of France, that M. Bazin had sent him many larvæ of *Silpha opaca*, which were more elongated than in the other known species: they were shining black, with a little yellow at the anterior margins of the segments; they were found in great numbers in some red-beet fields, and were accused of devouring the leaves of this useful plant, and thus causing great ravages in the plantations when the plants began to sprout. M. Guérin saw them eat the leaves of the red-beet which he gave them, as caterpillars would have done. M. Bazin and his son had detected these larvæ in their fields in great numbers, mounted upon the leaves of the plants and eating them.

The distance from Londonderry being so considerable, the larvæ transmitted by post did not reach me alive; and consequently I never had a chance of rearing the beetles to identify them. M. Guérin has been more fortunate, for at the beginning of July he saw a larva change to a pupa; the middle of the same month many buried themselves three or four inches in the earth, making a little oval cavity by kneading the soft earth with their head, aided by pressure exercised by the back, &c. On the 14th he saw a white pupa; and on the 24th the *Silpha* hatched. It remained two days white in the earth, gradually becoming brown, and eventually black, when it came forth. Some of Mr. Maxwell's larvæ also changed to grayish white pupæ, about three inches below the surface of the soil, but he did not obtain the beetles from them.

It is quite possible that these larvæ may be the offspring of different species of the genus *Silpha*, yet I am disposed to think the French and Irish

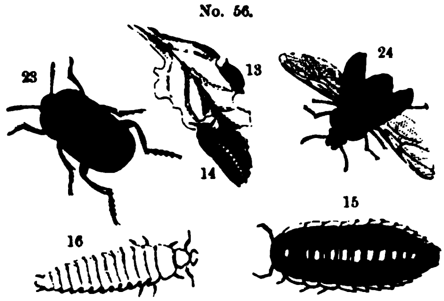
* *Annales de la Soc. Ent. de France*, for 1846, page lxxii.

are the same, supported as this supposition is by their similar economy. I observed some of the larvæ were longer and narrower than others, which may be merely a sexual variation.* It is not that they assume the broader form before being transformed into pupæ, for many of the small and young ones were equally short and broad in proportion. I think the one found at the artichoke roots is not the same species as those from the mangel-wurzel, for the antennæ are longer and stouter; and whether those Mr. Haliday has observed under marine rejectamenta are identical with the former I cannot ascertain at present.

These insects belong to the order COLEOPTERA, family SILPHIDÆ, genus SILPHA, and the species is referred to *S. opaca.*

The eggs are laid probably in the earth, but this remains to be proved; and the larvæ must have been hatched ten or twelve days when first observed, as they were 2 lines long (Plate M, and No. 56, figs. 13); when full-grown they are 4 or 5 lines long: figs. 14. They are very much the form of wood-lice (*Onisci*) as shown at figs. 15, but are black and shining; comprising thirteen segments, including the head, which is somewhat orbicular, with two impressions on the face; and the mouth is composed of five pieces: two mandibles or jaws (fig. 17), which are horny, cleft at the apex, forming two sharp minutely serrated teeth, and inside is a duplicate lobe (fig. 18), of similar form, but shorter; this is a member which I have not met with previously, and has no analogue in the perfect beetle. Below the mandibles are two secondary jaws called maxillæ (fig. 19), which are articulated and terminated by a broad hairy lobe, and to the outside is attached a longish palpus or feeler (fig. *g*), which is four-jointed, the apical joint conical; between these is placed the chin (fig. 20), with a short cleft lip (fig. *h*), and on either side is a short, stout, triarticulate palpus or feeler (figs. *i i*): the eyes are composed of four minute lenses, situated above the antennæ, which are inserted in cups on each side of the head; they are rather short, slender, hairy, and three-jointed (fig. 21); the basal joint is cylindrical and scarcely longer than the second, which appears to be notched inside near the apex, the third is slenderer and elongated: the thorax comprises three segments, the first being the largest; they have the angles rounded, but in the following segments

No. 56.



* This appears to have been confirmed by Mr. Maxwell, who bred a *female Silpha* from a broad short larva, and a *male* from a longer narrower one.

they are acute and give the sides a toothed appearance; the apical segment, however, is furnished with an acute spine on each side. It has six short legs, which are five-jointed; being formed of a hip, trochanter, a thick thigh, slender shank, and a strong acute claw: fig. 22. In some specimens the body had a narrow tawny margin (figs. 15), whilst others were narrower and more elongated: figs. 16; *f*, the natural length. When full-grown the larvæ bury themselves, and forming cells, change to pupæ in the earth, and from these emerge the beetles called—

3. *Silpha opaca* by Linné, but De Geer named them *S. tomentosa*, from their being clothed with short, tawny, depressed hairs, which are generally worn off in a short time, when they appear black, and exceedingly thickly punctured all over, the hairs having been inserted in these minute pores: the head is very much the form of that of the larva, and the organs of the mouth are not very dissimilar,* but the eyes are large and oval, the horns are twice as long, clubbed, and eleven-jointed; basal joint the longest, second longer than the third, five following more or less globose, the remainder forming a sort of club, the terminal joint reversed—pear-shaped: the thorax is twice as broad as the head, somewhat transverse oval, the surface undulating from impressions; scutellum rather large and triangular: wing-cases depressed, yet slightly convex, the outer margin reflexed, and there are three fine sharp ridges down each, curved next the hinder margin, which they do not reach, the outer one being considerably the shortest, and beyond the middle is a bump between the second and third striæ: the wings are ample, and folded in repose: the six legs are stoutest in the *male* (figs. 23); the shanks are spiny and spurred at the apex; the feet are bristly and five-jointed, the four anterior with the four first joints dilated in the male, especially the first pair; fifth joint clavate, and furnished with two strong curved claws. The *female* has slender feet: figs. 24, represented flying and magnified.

It would be advisable to try experiments for the expulsion of these larvæ when they trespass upon our crops; for at present no natural check to their multiplication has been noticed, and it is possible there may not be any parasites to prey upon them. Mr. Maxwell says, "Neither salt nor lime seems to have the smallest effect. I have tried both with no successful result." To hand-pick them appears to be hopeless, owing to their small size and great numbers; but probably some trap might be invented to decoy them to certain spots, where they could be more readily destroyed in masses. It would not be amiss to distribute sea-weed when they appear on crops near the coast: dead birds and quadrupeds, as well as tiles and boards, should be placed

* Curtis's *British Entomology*, fol. and Plate 742, where dissections and a coloured figure of the beetle are given.

between the ridges, to ascertain if they preferred any of the decomposing animals to the mangel-wurzel, or would congregate under sheltered spots, like wood-lice, earwigs, &c. As the parent beetles can fly, something may attract them to particular spots where they pair and lay their eggs; and these are important points to be ascertained in their economy. From the larvæ being so young when discovered, it is evident they must have been bred in the field, if not actually upon the quarter where the mangel-wurzel was sown. I am not inclined to think the eggs were introduced with the seed; yet it is not impossible, for we have testimony that the beetles have been found inhabiting the flowers of the mountain-ash, but for what purpose they resorted there is not discovered. Some of the seed previously to sowing should be subjected to sufficient heat to kill the eggs without destroying the vitality of the seed; or, by steeping it in brine, sowing it away from the rest, and examining it as soon as the larvæ made their appearance upon the crop raised from the unprepared seed, this important point would be settled, should there be no larvæ upon the plot experimented upon. A careful examination of the seed from an infected field should be made, to see if the eggs could be detected, for they must be very abundant to produce such large families; and repeated search ought to be made for the beetles upon the mangel-wurzel plants, especially those running to seed after the middle of July, when the *Silphæ* or beetles hatch, which are now made known by the figures 23 and 24, as well as by the descriptions. By such modes of experiment and search as are here recommended, and of course by others which will suggest themselves to the intelligent agriculturist, valuable facts will be collected, and good results may be expected.

Since the foregoing statements were made, I received a communication from Mr. Maxwell, dated 4th October, 1847, which greatly alters the aspect of this visitation; for it seems the farmer need not despair of a crop recovering from the depredations of these larvæ. Mr. Maxwell says, "The beet-root plants which remained after ploughing up the field, and whose leaves suffered in the manner represented to you, have altogether recovered from their injuries, and are in a most flourishing state; so much so, that from my experience of this year I should certainly not recommend the course adopted last year, but trust to the plants recovering the injuries sustained by them during the month of June, before the larva has buried itself to undergo its transformations. I observed again that the larvæ totally disappeared about the 1st of July, appearing first on the 4th of June. Most undoubtedly the leaves are the only part of the plant fed on by the insect, the roots being perfectly untouched."

CASSIDA NEBULOSA—*the Clouded Shield-beetle.*

M. Bazin, a proprietor at Mesnil St. Firmin, to the south of Paris, detected in 1846 considerable numbers of the curious larvæ of this beetle feeding upon the leaves of the red-beet. They reside on the under side of the leaves, which they nibble by degrees in small round spaces, and the leaves are thus riddled with little holes.* They also inhabit *Chenopodium hybridum* (the maple-leaved goosefoot), and feed upon the leaves in July.

The larvæ are of a pretty green colour, marked with white, and the margins of the body are armed with barbed yellow spines (fig. 25); they are oval and depressed, with a small scaly head, furnished with teeth and three minute eyes in an oblique line, like little black tubercles, and four others higher up; each side is furnished with sixteen sharp spines, which are very bristly; at the extremity of the body are two long spreading tails, which the animal turns over the back when at rest to support its shrivelled cast-off skins and excrement, which, like a parasol, shade it from the sun, and also protect it from being stung by parasites, but these tails are stretched out when the larva walks: the six pointed legs are concealed beneath the thorax. When they are prepared to change to pupæ, they fix themselves by the under side of the belly to the leaf which nourished them, and partially throw off their skin in two or three days. The appearance of this pupa is more remarkable than that of the larva; it is oval and depressed, with a large shield-like thorax entirely concealing the head; the margin is ciliated, and there are two white spots on the back; the segments of the body are cut on the sides like the teeth of a saw, the terminal one is spiny, and produces a forked tail: it is of a bright and lively green colour, with the margins of the thorax and abdomen whitish, and along the back are two yellowish white stripes (fig. 26).† In less than a fortnight, viz., about the beginning of August, the *Cassidæ* hatch.

They belong to the order COLEOPTERA, family CASSIDÆ, and genus CASSIDA, or shield-beetles, and this species was named by Linnæus—

4. *C. nebulosa.* When first developed it is green, but it gradually becomes of a tawny colour above and black beneath (fig. 27; *k*, the natural length); the little head is concealed under the large semi-orbicular thorax, which is stamped with minute impressions, having two white spots at the base; the black eyes are oval; the horns are inserted on the forehead, and are eleven-jointed, slightly thickened, and blackish towards the extremity, which is pointed; the scutellum is rather small and triangular; the wing-cases are oval

* *Annales de la Soc. Ent. de France*, for 1846, page lxxi.
† De Geer's *Hist. des Ins.*, vol. v. page 168.

and convex, with a flattened margin; there are five double rows of punctures on each, with black dots sprinkled over them: the two wings folded beneath are ample: the legs are short; the feet are four-jointed, with the third joint bi-lobed, the fourth furnished with a pair of claws.*

The larvæ sometimes fall victims to a parasitic fly, notwithstanding the protection we have alluded to; for M. Guérin says, one which was not transformed to a pupa, produced, on the 25th of July, from the middle of the back, thirty-nine very little *Chalcidites*,† black, with yellow legs, the eggs of which had been deposited by the mother upon the living larva.

ALTICA NEMORUM—*the Turnip-beetle or Fly.*

Since the history of this insect was written,‡ I have detected the little beetles hopping about the mangel-wurzel and puncturing the leaves. Mr. Rootsey, of Bristol, has also made the same observation.

By the more recently published accounts in France, it seems that the beet crops are subject to a very considerable variety of insect depredators, which either do not attack the mangel-wurzel in this country, or they have passed by unnoticed. In the south of France, M. Forbin-Janson established a large manufactory of indigenous sugar; as soon as the leaves of the beet sprouted an immense quantity of brown caterpillars (*Noctua brassicæ* probably§) entirely destroyed the crop. The following year the crop was first destroyed, it was believed, by some *Alticæ;* a second sowing was ravaged by the brown caterpillars, more numerous than before; a third year the same ravages obliged him to renounce his undertaking.|| But one of the greatest pests to the beet crops of France is a little beetle which infests the leaves and roots; it belongs to the family CRYPTOPHAGIDÆ, and bears the following names:—

5. ATOMARIA LINEARIS, *Steph.;* PYGMÆA, *Heer.*

It is elongate-linear, slightly pubescent, varying from black to rust colour: head broad and triangular; eyes slightly prominent; horns chestnut colour, as long as the trunk, slender, eleven-jointed, terminated by a three-jointed club: trunk depressed and margined; wing cases depressed; wings ample: six short chestnut-coloured legs, the feet five-jointed. Length, ½ to ⅔ of a line.

We learn from M. Bazin that this minute beetle is generated in great numbers, destroying the buds as they appear, and on removing the clods of earth one often sees innumerable quantities. It does not content itself at a

* See Curtis's *British Entomology*, fol. and Plate 127, for figures and dissections.

† *Annales de la Soc. Ent. de France*, for 1846, page lxxi.

‡ See chapter i.

§ Were not these the larvæ of *Agrotis segetum* and *A. exclamationis?*

|| *Annales de la Soc. Ent. de France*, for 1846, page cxvi.

later period by attacking the root, but when it is fine weather it comes out of the ground, ascends the stem, and devours the leaves. These little creatures often appear in families on a small plant, of which in a few hours nothing remains but a leafless stalk, which presently withers and dies. M. Bazin first observed this insect in 1839, at Mesnil-St.-Firmin; and, some years later, M. Macquard stated that it devoured the fields of red beet in the environs of Lille to such an extent that the cultivators were obliged to re-plough and re-sow the fields.*

The beetle appears in May and June, less seldom in July and August. It is abundant in England, and no doubt affects the crops of mangel-wurzel in this country. M. Bazin considers the following remedies as infallible:—1st. Fallowing. 2d. Heavy rolling. 3d. Good tillage. 4th. Powerful manure. 5th. Thick sowing. See *Cosmos*, v. 5, pp. 171 and 177.

ANTHOMYIA BETÆ—*the Mangel-wurzel Fly.*

It is generally supposed that animals closely related to each other, and forming a natural group, would not be very unlike in their habits of life, but such is not always the case amongst insects, in their larva state especially, and the genus of flies called *Anthomyia* is a remarkable example of such a diversity. There are several species that annoy the farmer and gardener, which bear so striking a resemblance to each other in their fly state, that, except to the scientific observer, they would be considered as the same species, yet nothing can be more different than the economy of the larvæ. Some of these maggots live upon the seeds of the lettuce whilst growing upon the plants; others revel in the decaying stems of cabbages, the bulbs of turnips and of onions; whilst others reside between the two skins of the leaves, feeding upon the pulp—and these have received amongst naturalists the name of miners. A gentleman at Cranford, who is well known for his scientific researches,† has made me acquainted with a fly whose larva mines in the leaves of the mangel-wurzel, and I am indebted to him for the following sketch of its economy:—"The maggots were brought to me from Surrey on the 26th of June, found feeding between the plates of the leaves, the integuments of which they cut rapidly, giving the parts attacked a blistered appearance. They were of a greenish colour, a quarter of an inch long, pointed at the head, and rather abruptly cut off at the tail: they turned to pupæ *in situ*, as you may see by the fragments of the leaves, and hatched July the 17th and 20th. Mr. Frogley told me they had destroyed the plant where he got them from. I found my sugar-beet attacked in the same manner, but immediately employed some boys to pinch

* *Annales de la Soc. Ent. de France*, 1847, page 1.
† Mr. F. J. Graham, author of a Prize Essay upon the Potato Disease.

the blisters between the finger and thumb, and by attacking them in that helpless situation their operations were effectually stopped."

I may remark, that the maggots are very similar to those of the turnip; like them they change to an oval brown pupa, and from them issues a fly which exceedingly resembles *Anthomyia ceparum*, which is bred from putrescent onions, but, as I cannot imagine they are the same species, I must distinguish them by naming the former, and shall call it after the beet or mangel-wurzel:—

6. *Anthomyia* (*Pegomyia*) *betæ*. The *males* only are known at present: they are much smaller than the Onion-fly, being only 2¾ lines long, and expanding about five lines: they are of an ashy-gray colour, clothed with black bristly hairs; head semi-orbicular; eyes large, brown, nearly contiguous above, with three minute ocelli on the crown; face satiny-white, with a bright chestnut-coloured line down the middle, in the centre of which are placed the little black drooping horns, the third joint being the largest, elliptical, and producing a naked bristle on the back; the protruding lip and palpi are also black: on the trunk are three or five indistinct longitudinal stripes; the six-jointed abdomen is linear, with a dorsal black triangular spot at the base of four of the segments; the two wings are ample and transparent, a little tinted with tawny at the base; the nervures are pitchy; poisers ochreous; six legs, longish, bristly, and pitchy, the shanks with a tawny tinge.

These insects will seldom cause any loss to the mangel-wurzel crops, should they ever abound to any extent; but whether they would prove injurious to cattle when the *leaves* are given as food I am not prepared to say, but I should think not, as the skins are very tender. I have seen the leaves of docks and bur-docks as well as the celery * blistered from the mining of the maggots of different species of flies to a large amount, and the only remedy is to nip them in the leaf, for they are so delicate that a very slight pinch will maim them. Parasites no doubt keep them under, and we may trust to them for assistance.

TIPULA OLERACEA—*the Crane-fly, or Daddy-long-legs.*

This universally distributed and mischievous gnat, by dropping its eggs in the field, garden, and pasture-land, annually causes serious losses to the cultivator by the destruction of various crops as well as flowers.† Not having space to illustrate the insect here, I shall leave its economy for a future chapter,‡ and merely state now, that two crops of mangel-wurzel plants were

* The maggots in the dock-leaves produce a fly called *Anthomyia solennis*. Those in the celery-leaves change to a handsome fly named *Tephritis onopordinis*. See *Gardeners' Chronicle*, vol. i. p. 660.

† Ibid. vol. i. page 612.

‡ See chapter xv.

successively carried off by the larvæ, or grubs, as they are called, which are the offspring of these flies, in the spring of 1845, near Southall, in Middlesex; and in the second week of June they destroyed a large plot of the same plants in a field at Hayes. On examining the dead and dying plants, we found the maggots about an inch below the surface of the soil, and close to the roots of the infested plants, which had been eaten through by them. As they swarm in all grass lands with other allied species, it is not safe to sow beet or turnips immediately after pasture-land has been broken up, without previously paring and burning, salting, or liming the land.

In the autumn, if the crown of the mangel-wurzel begins to rot, it is immediately taken possession of by numerous varieties of insects. I remember, at the end of October, 1846, finding vast numbers of specimens of a small beetle called *Cercyon Boletophagus,** which were inhabiting the cavities eaten probably by slugs. It is very smooth and shining, oval, of a pitchy colour, with the tips of the elytra, or wing-cases, ochreous; the clubbed horns and legs are tawny; it is not larger than a small turnip-seed. With them were multitudes of a minute, shining, tawny *Acarus,* oval in form, and looking like seeds when the six short legs were folded up. It appears to be the *Acarus,* or *Uropoda umbilica,* which attaches itself to beetles.†

This terminates the history of the insects which more or less injure the mangel-wurzel crops, and the following is a

SUMMARY OF THE FOREGOING CHAPTER.

A *weevil,* called *Otiorhynchus picipes,* destroys the young *pea-crops,* &c.

The weevils *conceal* themselves by *day,* and *feed* only at *night.*

The same *weevils* injure vines, wall-fruit, apple and pear trees, raspberries, &c., early in spring.

Their larvæ or *maggots* live in the earth upon the *roots of flowers,* &c.

They change to *pupæ* or chrysalides in the *earth.*

These *weevils* swarm in *hedge-rows* in May, feeding on black thorn, elm, and lime leaves.

The *larvæ* might be *destroyed* by a dressing of *salt* or *gas-lime.*

Dusting with *soot, lime,* or *wood-ashes* might banish the beetles, or *watering* with *gas-water.*

Tarred boards would protect *garden-crops.*

Hand-picking the most effective remedy in *nurseries.*

* Curtis's *Guide,* Genus 115, No. 9.

† Chapter vii. Plate G, fig. 49.

Sand-wasps, called *Cerceris*, capture the *weevils*, and bury them to support their young when the eggs hatch.

They *swarm* in some *sandy situations*, where the paths, banks, and gravel walks are riddled by them.

Insect plagues suddenly *appear* from changes in the *atmosphere*, and as suddenly *disappear* through the agency of *parasitic tribes*, &c.

Bean Aphides swarming on almost *every plant* during the summer of 1847.

Migratory Locust also not uncommon in various parts of *England* the same year.

Mangel-wurzel supposed formerly to be *free from* the attacks of *insects*.

Larva of a beetle, called *Silpha*, feeds upon the leaves, and destroys the young plants in May and June.

They have been detected in the *North of Ireland* and in *France*, doing great mischief from 1844 *to the present time*.

In 1844, 5, *and* 6 they seemed confined to *Londonderry*, but in 1847 they carried off the crops in *Tyrone*.

They leave only the *fibres of the leaves*, but do not touch the *root*.

No bones were *used* in *manuring* the fields in Londonderry.

In *England* these *larvæ* are *well known*, but have never affected the crops.

In the department of the *Oise*, in France, they have *destroyed* the *red-beet*.

The beginning and middle of *July* they change to *pupæ*, and *hatch* towards *end* of the month.

Possibly *more species* than one may have the *same habits*, as the larvæ vary in form, or this may be a *sexual distinction*.

Are the *eggs laid* in the *earth?*

They probably *hatch* the end of *May* or beginning of *June*.

Neither *salt* nor *lime* seemed to have the slightest *effect* upon the *larvæ*.

Sea-weeds and *dead animals* distributed in a field might *decoy them*, when they could be *destroyed* more readily.

The *parent beetles* can *fly*, but the *larvæ* are *bred in the field*.

Were the *eggs* introduced with the *seed?*

Seed should be *steeped in brine* or subjected to *heat* before sowing, to ascertain if either would free the crop from the larvæ.

Examine the *seeds* of an *infected crop*, to learn if the *eggs* be amongst them.

Search for the *beetles after July* upon the *stems running to seed*.

From the healthy state of plants accidentally left in the field where the crop was eaten off, it seems possible the *plants* may *recover* from the *attacks* of the *larvæ*.

Larva of a shield-beetle, called *Cassida nebulosa,* feeds upon ***leaves*** of *mangel-wurzel.*

They reside *under the leaves,* and also live upon *Chenopodium hybridum* in *July.*

The *shield-beetles hatch* in the beginning of *August.*

A minute *parasitic fly,* one of the *Chalcidites,* inoculates the larvæ with its eggs, which hatch and *feed* upon the *fat,* &c., of the victim.

The turnip-beetle, *Altica nemorum,* is now found to feed upon the leaves of the *mangel-wurzel* as well as on the turnip.

Beet-crops in France ravaged by the caterpillars of some *moth,* as well as by an *Altica.*

Atomaria linearis, a minute beetle devouring the buds, leaves, and roots of the beet plants, often rendering the cultivation of that crop impracticable.

Larvæ of flies greatly resembling each other are often exceedingly *different* in their *economy.*

Maggots of *Anthomyia betæ* discovered feeding on the *parenchyma* or pulp in *blistered leaves* of mangel-wurzel and sugar-beet, in the end of June.

The *flies hatched* the third week in *July.*

The *maggots* may be *destroyed* by merely *pinching* the *blisters* visible on the leaves.

They change to brown *pupæ* in the *blistered* leaves.

If the *maggots* do *no harm* to *cattle* when the leaves are used for green food, *little mischief* is likely to arise from their *presence.*

Larvæ of the crane-fly, *Tipula oleracea,* is a most *destructive* maggot in the *mangel-wurzel* field, carrying off entire crops by eating through the young *roots.*

Not safe to sow mangel-wurzel on fresh broken-up *pasture-land,* without *paring and burning,* salting, or liming the soil.

Rotten places and holes eaten by slugs in the roots of mangel-wurzel are *inhabited* by swarms of *insects,* and amongst them are large broods of a little beetle called *Cercyon Boletophagus,* and an *Acarus, Uropoda umbilica.*

EXPLANATION OF PLATE M.

Fig. 1. Shoot of a bean as eaten by *Curculio* (*Otiorhynchus*) *picipes.*
  a, Portions of excrement deposited by the weevils.
Fig. 2. A female weevil in repose.
Fig. 3.* A male walking.
  b, The natural length.
Fig. 4.* One of the mandibles, or jaws.
Fig. 5.* One of the maxillæ, or second pair of jaws.
  c, The palpus or feeler.

BEAN AND MANGEL-WURZEL CROPS.

A Weevil with its parasite injurious to Bean crops, and Beetles with their Larvae destructive to Mangel Wurzel

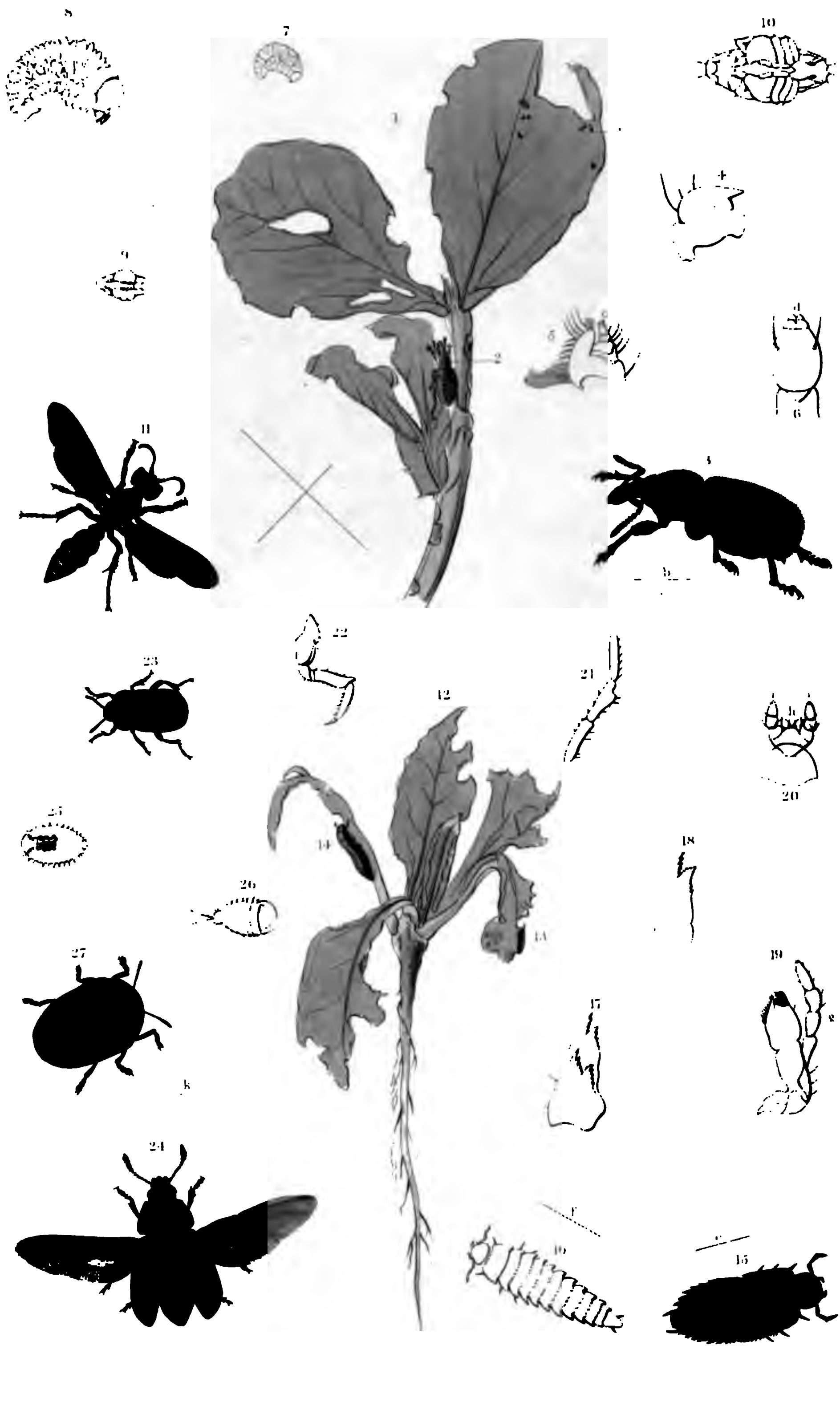


Fig. 6.* Labium, or lower lip.
d, Palpi, or feelers.
Fig. 7. Larva or maggot, dead and shrivelled.
Fig. 8.* The same magnified.
Fig. 9. Under side of pupa.
Fig. 10.* The same magnified.
Fig. 11.* *Cerceris arenaria* flying; a little larger than life.
Fig. 12. A young mangel-wurzel plant, eaten by the larva of a Silpha.
Fig. 13. The young larva feeding.
Fig. 14. The larva nearly full grown.
Fig. 15.* One of the larvæ.
e. The natural length.
Fig. 16.* Another of the larvæ.
f, The natural length.
Fig. 17.* One of the mandibles of the larvæ, the inner lobe shining through.
Fig. 18.* The inner lobe detached.
Fig. 19.* The maxilla.
g, The palpus, or feeler.
Fig. 20.* The mentum, or chin.
h, The labium, or lip.
i i, The palpi, or feelers.
Fig. 21.* One of the horns, or antennæ.
Fig. 22.* A leg detached.
Fig. 23. A male of *Silpha opaca*, running; scarcely larger than life.
Fig. 24.* The female magnified, and represented flying.
Fig. 25. Larva of the shield-beetle.
Fig. 26. Pupa of the same.
Fig. 27.* *Cassida nebulosa*, the beet shield-beetle.
k, The natural length.

Those numbers with a * attached, refer to the objects which are represented larger than life. All the figures are drawn from nature, excepting figures 25 and 26, which are copied from De Geer.

CHAPTER XIV.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING CARROTS AND PARSNIPS, INCLUDING PLANT-LICE, THE MAGGOTS OF FLIES, THE CATERPILLARS OF MOTHS, ETC.

As the tap-rooted vegetables are likely to become of more importance in field culture, both as food for cattle and man, an acquaintance with the enemies which assail and injure the carrots and parsnips must not be neglected, for such knowledge is actually necessary to their successful cultivation. As far as my own experience extends I am convinced that the parsnip is one of the best substitutes for the potato, not only as regards its nutritive qualities, but its produce also;* and when a taste for it is once acquired, it becomes a most agreeable culinary vegetable: it is also sufficiently solid to satisfy hunger, and it is gently aperient. The greatest objection appears to me to be the length of time it occupies the ground, as parsnips keep best *in* the earth; but this inconvenience, as far as the cottager is concerned, might be remedied by lifting the roots when full grown, about Christmas, and packing them vertically, close together, in some spare spot, from whence they could be drawn as they were wanted. I am also pretty certain that it is desirable to vary the vegetables which so largely contribute to the support of the labouring classes; for I have strong reasons for believing that potatoes, or any other vegetable, eaten day after day, will not conduce to health and strength as the use of three or four different sorts will alternately: the culture, therefore, of broad and scarlet beans, Jerusalem artichokes, and parsnips, would make a wholesome, agreeable, and profitable variety in the poor man's bill of fare, in combination with potatoes, greens, turnips, and onions.

Carrots are already so valuable in some counties, that the failure of them is severely felt; yet, with the exception of the turnip, I know of no crop which is more subject to the fatal attacks of the insect tribes in every stage of its growth. As soon as the tap-root is formed, until the period of its being matured, the maggots of a fly, as well as other little animals, including slugs, are constantly diminishing the produce. The young foliage no sooner appears

* See Col. le Couteur's valuable remarks in the *Royal Agricultural Journal*, vol. i. page 419, and Dickson's *Practical Agriculture*, vol. ii. page 718.

than it is filled with *Aphides*, and at a more advanced stage the leaves become an agreeable food for caterpillars; and lastly, the seed-crops are almost annihilated by smaller caterpillars, which devour the flowers as well as the seeds.

APHIS DAUCI—*the Carrot-leaf Plant-louse.**

In the first week of July, 1847, I visited the neighbourhood of Guildford, in Surrey, when Mr. Ellis showed me a field of carrots, which had been a strong plant; but one-tenth of the crop had recently gone off. This malady was indicated by the yellow foliage, and on pulling up the roots they were sound and clean; yet the crowns were not only discoloured, but dead or dying, and on opening the embryo leaves we found concealed at the base from two to seven or eight green *Aphides*. A few days after, Mr. T. Dickinson, of the Guildford Nursery, took me to a bed of carrots which was going off in a similar way. Here, however, the *Aphides* were gone, excepting a female, which had been punctured by some parasite; and it was evident they had commenced their operations earlier in the year, for the central leaves were hard and black. In this instance the tap-roots were becoming woody inside, and some of them were throwing out quantities of fibrous roots, like old growing carrots which had been kept through the winter.

1. These *Aphides* were scarcely larger than cheese-mites, of an uniform pale-green colour, with six legs, two horns, and no wings. I had hoped to have found them at a more advanced stage, when the females were bringing forth young, and some of them might have attained wings; I did not, however, remain at Guildford long enough, and I could not meet with them in Dorsetshire or in the Isle of Wight; but the beginning of July, 1848, Mr. Graham's bed of carrots at Cranford, which looked very healthy, was infested by numbers of *Aphides*, which were scattered over the leaves, and a great number of punctured ones were visible; from these were bred a parasitic *Cynips* and a minute *Trionyx*. The *Aphides* were small, principally green, but some of them were dirty-yellowish, tinged with red; perhaps these were the receptacles of the parasites: eyes black; horns short, seven-jointed, blackish at the tips; rostrum not long, stoutish, tipped with black; abdominal tubes rather long, subfusiform, orifices black; legs rather short, green; feet smoky; pupæ light-green, clouded with grass-green.

As soon as a bed is affected by *Aphides*, powdered tobacco should be dusted over the crowns of the carrots early in the morning whilst the dew is upon them, or they may be watered with a decoction of tobacco, which is fatal to

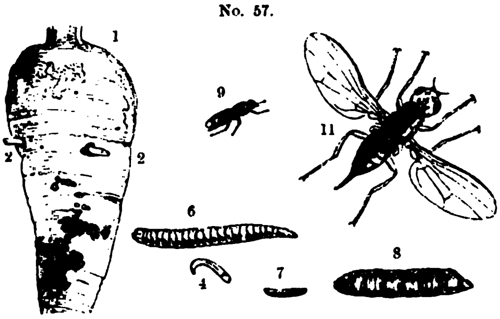
* Curtis's *Guide to an Arrangement of British Insects*, Genus 1047[b], No. 39.

all plant-lice. Removing the dying plants is of little use, as the insects remove from them as soon as the foliage produces no more sap. Another species of *Aphis* is found in October on the roots,* and being of an ochreous or pale yellow colour, it is not easily detected. The only specimens I have seen were small, apterous, and mealy, as such subterranean species generally are. They had two short horns and six short stoutish legs.

THE RUST.

This disease, which so materially affects the carrot crops and deteriorates their value, is occasioned in the first instance by the larvæ of a small fly. These maggots eat passages in the tap-root, as exhibited in Plate N, and No. 57, figs. 1, and the carrots gradually die off, changing to an ochreous or ferruginous colour where they have been eaten, whence they are termed "Rusty" by cultivators, and they become of little value; for the fibrous roots perishing, or being arrested in their growth, from a want of free and healthy circulation, the plants sicken if they do not immediately die: they lose their saccharine qualities, are consequently no longer sweet to the taste, and eventually they become black and rotten, especially when stored. The flies and their maggots are found through the summer, and the latter even in the winter, but they leave the roots to become pupæ in the earth, in which state they remain until the spring, but the summer broods hatch in three or four weeks.

No. 57.



On digging up some carrots in a clay soil the end of December, 1844, which were small and crowded from having been neglected, I found a considerable number of them maggot-eaten or rusty. On the tops were small black slugs; white Poduræ† were also running out and in to the cavities, and towards the apex of the roots large excavations were made, as represented at figs. 1, whether by slugs, worms, or millipedes, I cannot say. The most remarkable appearance, however, was occasioned by whitish, shining, conical objects sticking out of the sides horizontally, sometimes projecting nearly a quarter of an inch: figs. 2, 2. I soon saw they were maggots, which on being exposed to the light often withdrew themselves into the holes they had made in the carrot, and on dividing these longitudinally, various labyrinths were exposed,

* *Entomologist*, page 127.

† They are little skipping animals, thus named by Linnæus. See Curtis's *Guide*, Genus 4.

some of which entered the very heart of the root: Plate N, fig. 3; these cavities were dirty and brown, which colour was suffused to a considerable extent.

The maggots are ochreous and shining, cylindrical, pointed at the head and obtuse at the tail: they resemble cheese-hoppers, but they cannot leap: figs. 4; they are exceedingly transparent, so that every internal part is visible. The head is a black horny substance, which contains the mouth; this is alternately thrust out and contracted with great activity, the tip forming a hook, the base being forked like two spreading black horse hairs; the body is composed of eleven rings besides the head and tail, this being rounded and producing two little black horny tubercles (Plate N, fig. 5); from these extend two somewhat parallel pale lines which may be traced to the head; the intestines are also pale, but beneath the antepenultimate segment is a bag of reddish excrement, more of a purple tint than the carrot which it had been feeding upon: figs. 6, magnified.

The pupa is cylindrical, horny, shining, and coppery-ochreous: figs. 7; finely striated in rings, and of a pale rusty colour at the extremities; the head is sloped off very much, forming an oval concave lid, with a thickened margin, which lifts up to allow the fly to crawl out when it hatches, and in front are two minute black tubercles; the tail is rounded and furnished with two little black points: figs. 8, magnified.

The fly which it produces belongs to the order DIPTERA, the family MUSCIDÆ, the genus PSILA, and was named ROSÆ by Fabricius,* being found probably by him sunning itself upon the leaves of rose-bushes, and unfortunately he was unacquainted with its economy.

PSILA ROSÆ—*the Carrot-Fly.*

2. *P. Rosæ* is shining, of a pitchy black, with a greenish tinge, and clothed with pale hairs: figs, 9; the head, Plate N, fig. 10, is globose and rusty ochre, with a few bristles; eyes lateral, orbicular, and black after death; on the crown is a black spot with little simple eyes in triangle; the face slopes inward, and the two drooping horns are inserted under the projecting forehead; the third joint is oval and black at the tip, and on the back is inserted a pubescent ochreous bristle (fig. *a*); the trunk is oblong; the scutellum is small, trigonate, and rusty; the six-jointed abdomen is rather small, oval, and conical at the apex in the female, and furnished with a telescopiform contractile ovipositor: figs. 11; the wings lie horizontally on the back when at rest, and extend beyond the tail, being ample, iridescent, with a yellowish tinge, and all the nervures are bright ochreous; the poisers are small and whitish; the legs are bright ochreous,

* *Entomologia Systematica*, vol. iv. page 356, No. 181. Curtis's *Guide*, Genus 1303, No. 5.

and pubescent; the feet are five-jointed, the basal joint very long, the fifth small, with two little black claws and two small cushions or pulvilli: it is 3 lines long, and the wings expand 5 lines.

I am disposed to think that I have bred a closely-allied species from similar larvæ in the carrot roots, but the flies were so mutilated before I discovered them, that I cannot be certain; it seems, however, more than probable, because *Psila Rosæ* I have never found in my garden, whilst the species I allude to (*P. nigricornis*) is abundant there.

3. *Psila nigricornis* of Meigen* is very like *P. Rosæ*, but rather smaller, and the third oval joint of the horns is entirely black. I think it far from improbable that it may be only a variety of that insect.

It is not always the mature crops which suffer from these maggots, for some young carrot roots, sent to me in the first week in July, 1845, from Castle-Connel, in Ireland, were drilled through by them, as shown at Plate N, fig. 12; and previously, in 1842, young crops were similarly affected, but the maggots were not discovered where the spots existed, owing probably at that time to the minuteness of the recently produced larvæ.

With a view of rescuing the carrot crops from this pest, it has been recommended that as soon as the outer leaves become yellow and wither, which are indications that the root has been infested, such plants should be taken up without delay, and the grubs destroyed by immersing the roots in hot water.

If land be left, as allotments often are, to remain through the winter just as the crops have been drawn, not only that plot of ground, but the whole neighbourhood, may be deluged with noxious and troublesome insects; whereas, by trenching in the autumn, the pupæ of these and other flies are not only subjected to frost, snow, and rain, as well as extreme transitions of temperature, but the inhabitants of the soil are exposed to the prying eye of the robin and various birds, which subsist to a great extent upon insects and seeds during the winter.

Before sowing carrots, it is a great security against the Rust to give a dressing of spirits of tar and sand. It is even reported that pigeons' dung or cow-dung, pointed in at the time of sowing, will secure the crop from these maggots. Old turf well incorporated with quicklime, at the rate of eighty loads per acre, on a light soil, produced a fine crop entirely free from insects.† If quicklime alone be sown over the surface, let it lie two or three days and repeat the operation, after which it is to be ploughed in: this will free the soil from insects and slugs which prey upon the carrot crops, but of course the drier the weather is the better the lime will take effect.‡

* *Systematische Beschr. Europ. zweif. Insecktur*, vol. v. page 359.

† *Caledonian Hort. Soc.*, vol. vi. p. 2.

‡ *Gardener's Magazine*, vol. xvi. p. 208.

The spirit of tar, however, has been so often successfully tried, and it is so applicable to field culture, that I shall give the best directions I am able to obtain for its use. Take a barrowful of sand and pour a gallon of spirits of tar upon it by degrees, so as thoroughly to incorporate the whole mass, with the hands, then sow it over the surface of the field intended for carrots. The above quantity will be enough for sixty or seventy square yards. The object of uniting the spirits of tar with the sand is to divide it so minutely that a small quantity may be scattered over a large space; for it is believed that the scent is so offensive to insects, they cannot endure the soil where it is thus employed: under these circumstances the female flies would avoid such localities, and in all probability the spirits of tar would kill the young larvæ if even they hatched. Some cultivators have applied this dressing in the autumn, digging it in and letting it remain until the carrots were sown, whilst others have tried it after the sowing in April; and I have heard of its being sown at the same time as the seed, with equally good effect.* When it is dug or ploughed in during the autumn, it is supposed to drive the vermin to the surface, where they perish; and if repeated in the spring, after sowing, it no doubt renders the surface disagreeable to the flies, as I have already stated.

In the cage where I bred the *Psila* I found also a species of *Alysia*, somewhat allied to the *A. Apii*,† which I can only presume was a parasite connected with its economy, as it might have been introduced with the soil.

MILLIPEDES AND CENTIPEDES.

The *Polydesmus complanatus* is attracted to the roots which have been previously perforated by the maggots of the *Psila*, and sometimes congregates in such vast numbers, that I suppose it was this little animal which was reported to have devoured carrots by the acre in Scotland in 1831; but as the characters with figures of it have already been published in this volume, it is unnecessary to give any further description here.‡ It may, however, be added, that these Millipedes are said to crawl about the surface before sunrise, when they have been collected into cans by myriads and destroyed.§ A Centipede, named *Scolopendra electrica*, often accompanies the *Polydesmus*, and assists in such depredations.

THE OTTER-CATERPILLAR.

On cutting through a carrot in January, 1848, which was black and

* *Gardeners' Chronicle*, vol. ii. pages 365, 726, and 821; vol. iii. pages 5 and 86.
† See page 420. ‡ See chap. vii. page 203, Plate G, fig. 55.
§ *Scotsman*, for May 14, 1831.

decayed inside, I was very much surprised to find a cavity 2 or 3 inches long, and within a large white caterpillar, which unfortunately was so injured by the knife that it died. It was, however, unquestionably the larva of a Ghost Moth, named *Hepialus humili.** It was evidently preparing to change to a pupa, for it had cast its skin, which was pushed to the bottom of the cell, and a loose web was spun across the top. This fact shows that the Otter Caterpillar will feed upon roots very different in their nature from those of the hop. I must pass over the economy of this destructive insect for the present, as its history is more immediately connected with the hop gardens.

We will now leave the roots of the carrot, and proceed to investigate the injuries sustained by the foliage, flowers, and seeds, as they are successively developed.

PAPILIO MACHAON—*the Swallow-tailed Butterfly.*

This is the first to be noticed; but it is an insect so far from common, being entirely confined to certain localities in this country, that it is rather with a view of completing the history of the carrot insects, than from any necessity of guarding the agriculturist against its inroads, that it is introduced. It is, however, abundant in France, where the graceful evolutions of the Swallow-tailed Butterflies may sometimes be seen even in the gardens of towns. As England is being better drained, many native insects are expelled from their ancient haunts, and are becoming extinct in some districts: this is the case with *Papilio Machaon,* whose geographical range has been greatly circumscribed by cultivation within a comparatively short period. Some fifty years back, this conspicuous butterfly appeared annually in neighbourhoods where now it is never seen. My friend Mr. Dale, of Glanville's-Wootton, used to observe it annually sailing around his property in Dorsetshire, where now it may be searched for in vain, although the same hills, pastures, and plantations, remain pretty nearly as they were at the time alluded to: it was also formerly abundant at Westerham, in Kent, and around London; but at present, if any one wishes to find this beautiful butterfly, he must go to the fens of Cambridgeshire, Huntingdonshire, or Norfolk, where, at Burwell, Whittlesea, and Horning, thirty or forty may be taken in a fine day from May to midsummer.

The female butterfly will lay her eggs indiscriminately upon the leaves and flowers of carrots, the marsh milk-parsley (*Selinum palustre*), rue or fennel, in the end of May and in June. The caterpillars of various sizes and colours may be found feeding in June and July; and the butterfly is sometimes seen until the middle of August.

The caterpillars are black when first hatched, which colour they retain

* Curtis's *British Entomology,* fol. 185. *Guide,* Genus 791.

until they are half grown, being then ornamented with spots and rings of green, with warts producing minute brushes of bristles: when arrived at maturity, they are nearly 2 inches long, and as thick as a swan's quill; they are then beautiful objects, being quite smooth, of a charming green colour, with black velvety rings, upon which are orange warts, excepting the alternate rings, which form a junction with the segments, and are often concealed when at rest. They have six black pectoral legs like horny claws, eight fleshy abdominal feet, and two similar anal ones for holding firmly; but the most curious distinction in the structure is a forked apparatus, like a Y, of an orange colour, inserted behind the horny head, which the animal can thrust out or withdraw at pleasure; and this organ, which secretes an acrid fluid of an offensive scent, is believed to drive away the *Ichneumons* and other parasitic enemies, which would otherwise annihilate such a conspicuous species. It is generally in July that the transformation to the chrysalis takes place, when the caterpillar fastens its tail, spins a thread across its back, shoots off its skin, and assumes a yellow or green tint, with an interrupted black stripe on each side.

The butterfly is the largest and finest species produced in this country, belonging to the Order LEPIDOPTERA, the Family PAPILIONIDÆ, the Genus PAPILIO,* and it was named by Linnæus—

4. *Papilio Machaon*, and is called the Swallow-tailed Butterfly, from the two appendages which emanate from the hinder wings. It is yellow, with black horns: the head, trunk, and body are black, the sides striped with yellow: the upper wings have a large black space at the base freckled with yellow, the hinder margin is black with a line of yellow crescents; the nervures form black stripes, and there are three largish black patches above the disk; the lower wings have a broad black border with yellow crescents along the margin, and there are six freckled blue patches upon the back, with a brick-red eye-like spot at the anal angle, and a blue crescent above, the whole inclosed in a black ring; the tails are black with a yellow edge inside: the wings expand from 3 to 3½ inches.

Carrot and parsnip crops when left for seed are dreadfully injured by multitudes of rather small caterpillars, which roll up the leaves, spinning webs amongst the flowers and capsules, to enable them to feed in security, leaving nothing but the stalks and fragments of the fructification to reward the owner. This is so great a loss that it is well worth attending to; and by becoming acquainted with the habits of these insects, no doubt their ravages may be arrested.

* Curtis's *British Entomology*, fol. and Plate 578, where another species is figured, called *P. Podalirius*, which seems to have deserted our island.

They all belong to the Order LEPIDOPTERA, the Family TINEIDÆ, and the Genus DEPRESSARIA of English authors, but in Germany and France they are generally described under the generic term *Hæmilis*. One species is named—

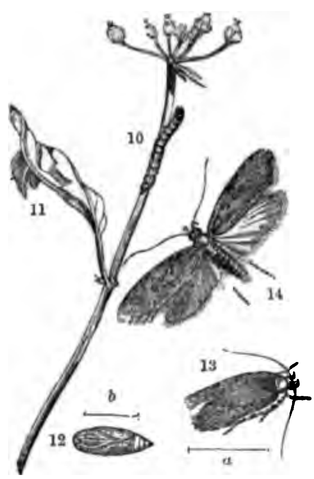
DEPRESSARIA CICUTELLA—*the Common Flat-body Moth.*

a vulgar name which it has received from its depressed abdomen, to which also the Latin generic name alludes; and the scientific specific one is no doubt applied from its inhabiting a cow-bane named *Cicuta*, one species (*C. virosa*) being a very abundant plant in our ditches: the caterpillars are also found upon the wild chervil (*Chærophyllum sylvestre*) and gout-weed (*Ægopodium podagraria*), weeds equally abundant in our hedges. These are all *Umbelliferæ* as well as the carrot (*Daucus Carota*), about which the moths are usually seen flying to extract honey from the flowers. The common flat-body moths seem to be domestic species, for they enter our houses and are often mistaken for clothes-moths, from their frequenting rooms which are seldom used, and are seen upon the curtains, walls, and windows of our sleeping-rooms in the evening. They endeavour to avoid the light, running about with much activity, and gliding over the surface until they can find a quiet corner to conceal themselves in. They also fly well and rapidly; and the females, which live through the winter, lay their eggs upon the flower-heads, or umbels as they are called, or in the axilla of the leaves, for in June the caterpillars are large enough to be discovered, and immediately cut the leaves of the chervil or carrot to bend and form them into little tunnels, which are held together by threads; in these they reside, feeding as it were upon the walls of their habitation, and when these are consumed they remove to another leaf, which is rolled up in the same way. Each end is left open to allow the caterpillars, when they are alarmed or disturbed, to fall to the ground by a thread proceeding from the mouth. This is necessary to enable them to escape from their natural enemies, amongst which are the Solitary-wasps (*Odyneri*),* which fill their cells with this kind of caterpillar to support their young. They are exceedingly active, wriggling backward and forward, and jumping from one side to another, when touched, as if in convulsions: they are ½ inch long, of a grass-green colour, with a darker green line down either side and one along the back; on each segment are ten warty black points, four disposed in a quadrangle on the back, and three obliquely on each side: the head is brown with two brighter spots of the same colour; the thoracic scale is brown with a broad black margin, and they have sixteen green legs (No. 58, fig. 10).

* Curtis's *British Entomology*, fol. and Plate 137.

When they are ready to change to pupæ they become rosy beneath, very restless, and continually wander about as if seeking for food. Sometimes it appears they enter the earth to change to pupæ,* where they form little oval cocoons of grains of sand, loosely attached by silken threads, the inside being lined with silk, or they undergo their transformations in the habitation formed in the leaf (No. 58, fig. 11).† The chrysalides are of a deep yellow brown, and shining (No. 58, fig. 12; *b*, the natural length). There are two broods annually; the June one hatches in August, and the caterpillars found the first week in September become moths in the end of October, and they hybernate.

No. 58.



5. *D. Cicutella* is supposed also to be the *Pyralis applana* of Fabricius. It is of a dull pale reddish ochre colour, and shines like satin: the eyes are small, black, and orbicular; the horns are long and slender, and the palpi or feelers are curved upward like short scaly horns, but the apex appears naked and pointed: the trunk is orbicular, the body depressed, the tail tufted with ochreous hairs in the male, lanceolate in the female: the wings rest flat upon the back in repose, one lying over the other (Plate N, and No. 58, figs. 13; *a*, the natural length); the upper wings are long and narrow, freckled with brown and black, forming indistinct spots upon the pinion edge, along which is a light streak; on the disk are three white dots with dark edges, and two brown dots nearer the base: the under wings are yellowish gray, very satiny, with a longish fringe: figs. 14, magnified, the expanse of the wings being 10 lines.

DEPRESSARIA DEPRESSELLA—*the Purple Carrot and Parsnip Seed Flat-body Moth.*

A variety was figured under that name by Hübner,‡ in which the pale marks on the upper wings were entirely wanting, and this led me to publish it under another appellation.§ This species is less generally distributed than *D. Cicutella*, yet it is abundant enough in some districts. It is, I believe, confined to the more northern latitudes, being very common in Bohemia and around Berlin, as we learn from M. Fischer de Röslerstamm, who remarks—

* De Geer's *Hist. des Ins.*, i. 424. † Godart's *Lep. de France*, xi. 129, Plate 290, fig. 4.
‡ *Samlung Europ. Schmet. Tineæ*, Plate 61, fig. 407.
§ *D. Bluntii;* Curtis's *British Entomology*, fol. and Plate 221.

"It is astonishing that this species, so injurious to kitchen-garden plants, should be so little known and in so few collections, for M. Bouché, of Berlin, finds it by thousands."* It also inhabits the wild parsnip (*Pastinaca sativa*), along the shores of the Thames, especially around Southend, where it was found and bred from the caterpillar by the late Mr. E. Blunt and Mr. C. Parsons; but I have never seen the larvæ, which feed in society in July and August upon the flowers and capsules of the carrot and parsnip. There they also change to pupæ in a light gray web. In the autumn the habits of the caterpillars are somewhat altered, for they eat into the stalks, to winter there and undergo their transformations. Early in the spring, or even at the end of winter, if mild weather prevails, the moths hatch, come out of the hole in the stalk, previously made by the entrance of the larva, and fly about; but on the return of cold or bad weather they shelter themselves in holes, thatch, outhouses, under loose bark, in chinks of trees and paling, under stones, &c.

6. *Depressaria depressella* varies in the size of the sexes: the *male* only expands 6 lines, Plate N, fig. 15: it is of a yellowish mouse-colour and silky; the horns are not long; the round eyes and tips of the recurved palpi are black, the latter are ochreous at the base; the head and thorax are also ochreous; the tail is blunt; the upper wings are of a chestnut colour with pale ochreous scales on the disk, more or less visible, sometimes wanting, at others forming patches. The wings of the female expand 8 or 9 lines, and are similar in colour to the male, but the upper ones are generally brighter chestnut, and the whitish scales unite and form a somewhat irregular oval mark, open at the top; the tail is pointed: fig. 16, magnified.

Although the caterpillars of this species are very abundant on carrot-seeds, they prefer the parsnip, which has induced gardeners to set parsnips amongst carrots left for seed, in order to attract the moths to them, so that the caterpillars may be more readily collected and destroyed. Bouché has never observed this species upon the common cow-parsnip (*Heracleum sphondylium*), which is a favourite resort of some species. It may be advisable to add his description of the caterpillar, which resembles that of *D. Daucella*, but it is much smaller: the ground-colour is pale brownish gray; it is rough with black spines producing single hairs; the hairs have large white basal warts, which are arranged like those of *D. Daucella*: sides of the body with inflated edges: spiracles black: head, thoracic plate, and pectoral feet deep black: abdominal feet having the soles furnished with a ring of hooks: length, 3½ lines.

DEPRESSARIA DAUCELLA—*the Gray Carrot-blossom Flat-body Moth.*

This is a third species of the same genus of Moths whose caterpillars con-

* Godart, *Lep. de France*, vol. xi. page 140.

sume the flowers and seeds of the carrots and parsnips in July and August, causing great damage and sometimes destroying the entire crop; each caterpillar taking possession of an umbel of flowers, which it draws together in the centre by the fine threads that are spun from the mouth; fig. 17: in the midst of this resides the active wriggling caterpillar; fig. 18: which is at least ½ inch long when full grown, of a greenish gray colour, inclining to yellow, with minute black warts, emitting short hairs scattered over the segments: there are also indistinct longitudinal streaks down the back; the horny head and back of the first thoracic segment are brown or black. Some change to pupæ amongst the web and stalks of the umbel, whilst others (the later broods probably) bore into the stems to undergo their metamorphoses. The pupa is dull brown with pitchy limb-sheaths, very finely punctured: fig. 19.

7. The Moth, named *D. Daucella*, after the carrot, is ashy gray: the horns are like slender threads; the palpi or feelers are curved upward: the head and thorax are reddish brown, freckled with black: the upper wings are also reddish brown with white atoms scattered over them, and black interrupted lines forming streaks and dots along the nervures, especially towards the hinder margin; the under side of the upper wings is dark; the under wings are light gray: it expands 10 or 11 lines.*

This species does not appear to be frequent in England, but it has been observed on the chalky soil of Kent, in Devonshire, and different localities around London.

There are several modes of arresting the mischief which all the caterpillars of these moths occasion. We have stated that the larvæ are very sensitive, and fall down by a thread when disturbed: if therefore the flower and seed-heads were shaken over a sieve, with a piece of paper at the bottom to prevent their escaping through the apertures, garden crops at least might be freed from them. I expect also if powdered hellebore were dusted over the umbels, when the dew is upon the plants, that it would compel the caterpillars to desert their quarters, and it would be worth while to try lime and soot also.

The best process, however, for banishing the *D. Daucella*, which is perhaps the most mischievous species, has been suggested to M. Bouché from a knowledge of its economy. He has ascertained that the moths prefer laying their eggs upon the *parsnip;* he therefore plants in his carrot fields parsnips at 6, 8, or 10 feet asunder, which attract the moths; the eggs are consequently deposited upon them, and the caterpillars will not abandon the umbels on which they were hatched for those of the carrot. By this simple measure

* *Tinea Apiella*, Hüb. *Schmet. Tineæ*, Plate 14, fig. 94. Bouché, *Nat. der Ins.*, page 124.

he finds, at the time for gathering the carrot-seed, that it is not only preserved from the attacks of the caterpillars, but also, being all attached to the parsnip-heads, by collecting and burning them, these troublesome little pests may be nearly eradicated. He justly observes, that this operation must be cautiously performed, otherwise the lively caterpillars will fall out and escape; to prevent this, on approaching the parsnip plant, the infested heads should be instantly bent over a sieve or tub, and cut off, so that the contents may be burned without loss of time; or he proposes that the parsnips might be left until the caterpillars were changed to chrysalides; but this would be a dangerous delay, if any of them descend and enter the earth to undergo their transformations. If they all become pupæ in the umbels or stalks, the proposition is a good one, but such, I am pretty certain, is not invariably the case.

These caterpillars are not free from parasitic enemies; indeed two have been bred from those of *Depressaria Daucella* by Bouché.* They both belong to the Order HYMENOPTERA, and Family ICHNEUMONIDÆ: the first is comprised in the Genus CRYPTUS or PHYGADEUON, and was named by Fabricius—

8. *Cryptus (Phygadeuon) profligator.*†—It is black; the abdomen oval, red; petiole narrow and black; legs stout, shanks and thighs red, apex of the hinder thighs black in the male: horns of female with a white ring: four wings, transparent or slightly smoked, stigma rusty; areolet five-sided: abdomen dilated towards the apex in the female; ovipositor one-third or one-fourth as long as the body: length from 2 to 3½ lines.

This *Ichneumon* is found on umbelliferous flowers, and the female deposits her eggs in a great number of the caterpillars of *Depressaria Daucella.* The second parasite has been named—

9. *Ophion (Pristomerus) vulnerator* by Gravenhorst.‡—It is black, with the middle of the body red: anterior legs red, black at the base, hinder red and black alternately; the thighs with a tooth beneath: ovipositor black: oviduct chestnut colour; scarcely so long as the body: length, 2 to 3½ lines.

This parasite is also often concealed in its maggot state in the caterpillars of *D. Daucella* and other kindred species; both sexes frequent the parsnip when in flower, in the beginning of July, and have been taken in the market gardens round London. In the second week of July, 1849, I bred from a single caterpillar off the parsnip, a *female Microgaster*, allied to *lacteipennis*, and about thirty *females* of *Encyrtus truncatellus*, which no doubt were parasitic on the *Microgaster.*

* *Garten Insecten*, pages 151 and 155.

† Gravenhorst, *Ichn. Europ.*, vol. ii. page 729, No. 203. Curtis's *Guide*, Genus 500, No. 203.

‡ *Ichn. Europ.*, vol. iii. p. 724, No. 149. *Pachymerus vulnerator;* Curtis's *British Entomology*, fol. and Plate 624; *Guide*, Genus 535ª, No. 149.

I am not aware whether the caterpillars of the *Depressariæ* ever do much mischief in England, but if they have not yet been abundant, it is in all probability owing to the comparatively small quantity of carrot and parsnip seeds grown in this country, and this will be no security against their appearance at some future period; for owing to the rapid intercourse between distant countries, from peculiar atmospheric changes, and from unknown causes, certain species of insects appear and disappear in almost a mysterious way; but it is incontrovertible that if a vegetable be cultivated to any extent in the open ground, that its enemies will not be long before they come to claim their portion (not unfrequently the lion's share) of the produce. As these subjects are more generally studied and better understood, their importance and value will become more evident. Even the remedies suggested and the hints thrown out, if they be not immediately acted upon, may some day fall on good ground and bring forth fruit abundantly to the advantage of the farmer and the public.

The vast percentage of our vegetable produce which is consumed, not by man, but by insects, those almost unobserved visitors, is really incredible. In a wild state of nature their services are most important in reducing the superabundance of rank vegetation; they are not only the scavengers, but the labourers, whose unceasing industry thin the crops and keep both trees, shrubs, and flowers from smothering one another with their luxuriance: at the same time they are manuring the soil and rendering it more productive and more speedily applicable to the wants of the human species: but when the soil is subjected to the skill and industry of man, and the produce is to be the reward of his anxiety and labour, the farmer and gardener consider, naturally enough, that the services of a great many insects might be dispensed with, advantageously to themselves and no doubt with benefit to the public.

Before attempting to wrestle with such insidious enemies, three things are most essential—knowledge, industry, and perseverance. Wanting the first, we may do more harm than good, by destroying our friends instead of our enemies: without industry the economy of insects can never be attained; and if we have not a great share of perseverance, the best conceived remedies may prove futile. "Practice with Science" in every department of agriculture, must lead to useful results; and I trust, amongst others, that the science of Entomology, especially that branch of it which embraces the natural history of insects (*i.e.*, their habits and economy), will not be neglected by the agriculturist, who has the best means in his power for furnishing men of science with the materials wanted to dispel erroneous notions and clear up doubts, as well as placing them in a better position to assist the farmer in saving his crops, when they are threatened by those powerful armies, often composed of atoms, it is true, but whose combined force is sometimes irresistible.*

CALLIMOME DAUCI—*the Carrot Gall-fly.*

When the carrots are in full flower, the umbels often appear distorted, and on examination one finds a number of small vegetable galls that are produced, it may be presumed, by the punctures of some *Cynips* or *Cecidomyia* when the eggs are laid. It is a very singular fact, but there are a few groups of flies which have the power of causing a derangement in the sap-vessels, and an extravasation of the fluids, giving rise to excrescences assuming the most remarkable figures. The greatest number are formed upon the oak, one of them being the gall of commerce; others are the oak-apples, and the bedeguar, or moss-like balls upon the stems of dog-roses, which must be known to everybody. These are all the creations of different species of *Cynipes,*† but a beautiful little fly of the same genus as the carrot gall-fly is also produced from them, which is no doubt a parasite. The female *Callimome* is furnished with a slender oviduct as long or longer than the body; this she insinuates through the cuticle of the plant, to deposit her eggs in the maggots of the *Cynips,* which reside in the centre of the galls, where they undergo their transformation to pupæ, and subsequently the flies are hatched and emerge from a hole in the gall, excepting those which are inoculated by the *Callimome;* and it is very singular, but from the galls of the carrot I never bred any other species, and consequently the *Cynips* or *Cecidomyia* ‡ which by analogy ought to produce the galls, is unknown to me at present. I first observed the carrot-galls in the Isle of Wight, about the middle of August, upon the umbels of the wild carrot. On opening the galls, they contained little maggots of a bright orange colour, from which I bred a great number of both sexes of *C. Dauci* the following September.

These beautiful flies belong to the Order HYMENOPTERA, the Family CHALCIDIDÆ, the Genus CALLIMOME; and the Species immediately connected with this subject was named by me—

10. *C. Dauci,* from its being bred from the carrot.§ The *male* is of a brilliant metallic green; the horns are thirteen-jointed and black, basal joint green; the head is short and broad, thickly punctured; the compound eyes are

* Dr. Barton, as quoted by Dr. Asa Fitch, in his admirable *Essay on the Hessian Fly,* says that this little pest has been more destructive "than would be an army of 20,000 Hessians," who were believed to have introduced this dreadful scourge into the United States, with the straw they carried over with them.

† Curtis's *British Entomology,* fol. and Plate 688. *Guide,* Genus 564.

‡ The same genus as the wheat-midge. Chap. ix. page 260.

§ Curtis's *British Entomology,* fol. 552. *Guide,* Genus 646.

lateral and orbicular, the simple ones form a broad triangle on the crown; the thorax is oval and punctured, the sections deeply marked: the abdomen is smaller than the thorax, somewhat spindle-shaped, very glossy, scooped out at the base, the apex with a short horny process: the four wings are as transparent as glass, but iridescent; the superior have an ochreous nervure along the costa, which terminates beyond the middle in a little dot: the legs are straw colour, the coxæ and thighs are metallic green, the apex of the latter ochreous; hinder shanks pitchy, excepting the base and apex; feet five-jointed, hips black, terminated by minute claws and cushions: length, 1¼ line; expanse, 2½: fig. 20. *Female* larger; 1½ line long, ovipositor ¾ line long: fig. 21, magnified: bright green like the male: the horns are also black, but the long basal joint is straw colour with a dark streak on the back: the abdomen is not concave at the base, and it is terminated by a long ovipositor composed of an oviduct inclosed between two black hairy sheaths: the legs are coloured like those of the male.

Callimome Dauci is sometimes considered the same as Olivier's *Cynips auratus*,* and it is also stated to be the *Torymus muscarum* of Nees,† but my specimens do not agree with their descriptions, and the economy of them is totally different.

It would scarcely be possible to eradicate these insects without destroying the seed-crop, and as it is almost certain that they are the destined check upon some *Cynips* or *Cecidomyia* which first creates the galls, by burning the infected umbels our friends would fall victims to such a measure, as well as the actual offenders.

Tephritis solstitialis.

This beautiful fly is abundant on thistle blossoms during the summer, and being named by Fabricius *T. Dauci*, ‡ which implies that he had reasons for believing that it was connected with the carrot crops, I cannot pass it by unnoticed, although I am unable to illustrate its history further than to state that *T. cuspidata* of Meigen,§ which is, I think, correctly considered as a variety only of *T. Dauci*, breeds in the cells of the flower-heads of thistles.

This dipterous fly was named by Linnæus‖—

11. *T. solstitialis.*—Its head and horns are reddish ochre; eyes green; thorax olive green; scutellum yellow; abdomen black, with a long black horny oviduct in the female; wings with two or three smoky bars, and the

* *Encyclopédie Méthodique*, vol. v. p. 781.

† *Hymen. Ichn. Affin.*, vol. ii. p. 58.

‡ *Entom. Syst.*, vol. iv. p. 358.

§ *Syst. Besch. Europ. Ins.*, vol. v. p. 328.

‖ *Fauna Suecica*, No. 1879.

apex is margined with the same; legs ochreous: length of male, 1¾ line; of female, 3 lines.

Parsnip roots do not seem to suffer any very material injury from the insects which attack them and their allied neighbour the carrot, and they may be grown successfully upon a heavier soil. Parsnips certainly get rusty in the spring, and even in January I have detected the larvæ of *Psila Rosæ* in them, which is already described as so destructive to carrots, but the inroads of these larvæ do not destroy the flavour of the parsnip, as they do of the carrot: neither do parsnips fall a sacrifice to the *Aphides*, nor are the young plants carried off by wireworms, caterpillars, or the maggots of the crane-fly (*Tipula oleracea*).* The leaves are frequently blistered by the same insect which infests celery leaves, and I shall therefore proceed to its history.

TEPHRITIS ONOPORDINIS—*the Parsnip and Celery Miner.*

Tephritis is a group of lively flies, which delight in the sunshine, when they run fluttering over bright leaves, vibrating their beautifully spotted wings, which are carried erect, somewhat like those of the butterflies. About fifty species inhabit this country,† but with the exception of *T. Onopordinis*, another named *T. Artemisiæ*, whose maggots mine the leaves of the garden chrysanthemums, and possibly *T. solstitialis*, alluded to on the preceding page, there are none that are guilty of any injury to cultivated plants, I believe. A great number of them infest thistles and other Syngenesiæ.

T. Onopordinis I have bred as early as March; but from the middle of May to the end of July the flies may be seen in sunny days in gardens, hedges, at the skirts of woods, or wherever such flowers grow as are an agreeable resort for the males. The female runs over the leaves of the celery and parsnip, and with her telescopiform oviduct she no doubt pierces the cuticle and deposits her eggs, apparently singly; these hatch and produce little transparent maggots, which feed upon the parenchyma, or pulp of the leaf, causing large blisters upon them; and when two or three larvæ are feeding on the same leaf, the blisters unite and form large discoloured patches (fig. 22), for the inflated skin, which at first is pale or whitish, as it dries becomes yellow or tawny, and the maggot may be distinctly seen when the leaf is held up to the light: fig. 23. Thus the leaves are disfigured from midsummer to near Christmas,‡ and as the maggots arrive at maturity, they

* See chap. xiii. p. 397, and chap. xv. *Gardeners' Chronicle*, vol. i. p. 612.

† Curtis's *British Entomology*, fol. and Plate 241. *Guide*, Genus 1300.

‡ When the plants are left for seed, the leaves are blistered in May, and the larvæ are full grown at that time.

either change to pupæ in the blisters amongst the excrement of the larvæ, or pierce the skin, and falling upon the earth, undergo their transformations in the soil, and from these the flies are again produced.

These two-winged flies belong to the Order DIPTERA, the Family MUSCIDÆ, and the Genus TEPHRITIS: the species was named by Fabricius *—

T. Onopordinis, from its frequenting the cotton-thistle (*Onopordum acanthium*). It varies in the spots of the wings, which has led the same author to describe a variety under the name of *T. Centaureæ*, from its resorting to another genus of composite flowers. The eggs I have never seen, but the larvæ, fig. 24, are nearly 4 lines long, shining pale green; they look fat and somewhat transparent, so that the alimentary canal is visible along the back, forming a darker line: fig. 25, magnified: it is attenuated to the head, which is pointed, and the tail is blunt and tubercled; the body is divided into segments, and the sides are wrinkled. The chrysalis, fig. 26, f. 27, magnified, is horny, pale yellow, glossy, and oval; the segments deeply impressed from the contracting of the maggot, of which this is only the indurated skin, for maggots do not cast their skins as caterpillars do. When one of the pupæ was opened in February, a delicate nymph of a beautiful green colour was seen inside; and when the fly is perfectly matured, it elongates its body, which is filled with a thick cream-like fluid, or meconium; the pupa-case cracks at the head, and through the opening the fly walks forth.

12. *T. Onopordinis.*—The *male* (fig. 29, magnified) is about 2 lines long, and the wings expand 5 or 6 lines: it is shining, tawny, with a few black bristles scattered over the head and thorax: the lower part of the face and the two little drooping horns are yellowish; the latter are three-jointed, with a black bristle ochreous at the base, attached to the back of the third joint, which is oval; at the lower part of the face is a large cavity to receive the mouth, which is composed of a fleshy hairy bilobed lip, two long hairy fleshy feelers, and a short strong horny pointed tongue; † the lateral compound eyes are remote, ovate, and deep green; and there are three little simple eyes forming a triangle on the crown upon a dark spot: trunk ovate, the scutel semi-ovate: abdomen somewhat oval; wings ample, iridescent, transparent, variegated with brown, forming spots of various sizes; poisers small, clavate, and ochreous: legs six, ochreous with short black hairs; feet five-jointed, terminated by two small claws and two lobes or pulvilli between them. *Female* larger, abdomen broader, with a longish retractile ovipositor: fig. 28. In some varieties the trunk and abdomen are pitchy.

Securely as the maggots of these flies mine beneath the surface of the

* *Entom. Syst.*, vol. iv. p. 360. Trypeta, *Meig.*, vol. v. p. 316.

† See Curtis's *British Entomology*, Plate 241, for dissections.

leaves, there are two little parasites which fly and run about to detect them in their habitations, and by depositing their eggs in them they arrest the multiplication of the *Tephrites* to a considerable amount.

They both belong to the Order HYMENOPTERA, but one is of the Family ICHNEUMONES ADSCITI; it is included in an extensive Genus called ALYSIA;* and from its having been produced in the first instance from blistered celery leaves (*Apium graveolens*), I named the species—

13. *A. Apii.*—It is pitchy black and shining; 1½ line long: the wings expand 4 lines: the horns are like slender pilose threads, longer than the whole body, and composed of a multitude of little joints; the first joint rust-coloured beneath, the little second joint entirely ferruginous: head large and broad, with two small lateral eyes, and three simple ones forming a triangle on the crown; mouth with an upper and under lip, the latter with two four-jointed hairy feelers; there is also a pair of tridentate spreading jaws, and two hairy lobed maxillæ, furnished with very long slender six-jointed and hairy feelers: the trunk is elongated and oval: the body is broader, oval, pitchy, seven or eight jointed, and rough at the base, where it is very much narrowed, the second segment is sometimes rusty at the base; it is depressed in the males, but slightly compressed in the females, with a short, scarcely visible ovipositor; four wings very iridescent and pubescent; superior very ample, with one large marginal, three submarginal, and two small discoidal cells; stigma very long and slender, smoky, as well as the nervures; under wings very much smaller: six legs ochreous, hinder the longest; feet five-jointed, tips smoky, and terminated by minute claws.

These little Ichneumon-flies were bred in June from the pupæ (fig. 26 and 27), and were abundant about thirty years since, but I never meet with them now.

The other parasite is included in the Family CHALCIDIDÆ, and the Genus PACHYLARTHRUS: it is named by Mr. Haliday, from its brilliant emerald colour—

14. *P. Smaragdinus.*† —It is only 1¼ line long, and scarcely expands 3 lines: it is of a charming green colour, thickly punctured: the *male* has bright ochreous horns, composed of thirteen joints, the basal one very long, the third and fourth exceedingly minute; the maxillary feelers are terminated by a large oval orange joint: ‡ the head is broad, the compound eyes are black, with three little simple eyes in triangle on the crown: the trunk is

* See Curtis's *British Entomology*, fol. and Plate 141.

† Curtis's *Guide*, Genus 631, No. 1. *Phagonia Smaragdina; Brit. Ent.*, fol. and Plate 427.

‡ Ibid. fig. iv. and other dissections.

obovate and not so broad: the body is still narrower, small, oval, and of a metallic lustre; the base is contracted, and at the extremity is a curved horny sexual organ; the four wings are transparent; superior ample, nerveless, excepting a costal nervure, which forms a short capitate branch beyond the middle: six legs clear ochreous, coxæ green; feet five-jointed, tipped with brown. *Female* larger, blue green; horns black; feelers not incrassated: abdomen larger, with an oviduct concealed beneath; legs ochreous white; thighs green, excepting their tips; middle of shanks brown; tips of feet black.

I have frequently bred these splendid little flies in the end of April, in May, and October, from the pupæ of the *Tephritis Onopordinis*, but whether the *Pachylarthrus* is a direct parasite, and punctures the larva of the *Tephritis*, or lays its eggs in the pupæ already occupied by the *Alysia*, which in all probability is the case, has not been ascertained.

The *Alysia* is undoubtedly a natural check, which is provided to arrest the excessive multiplication of the celery and parsnip flies; and the *Pachylarthrus* may be the agent to regulate the multiplication of the *Alysia*, in order that the *Tephritis* may not be exterminated. It is not, however, difficult to free a crop from the maggots, and although they have not been detected in affecting the parsnips materially, they have entirely destroyed the most promising crops of celery, and there is one, if not more wild plants, in whose leaves the eggs are also deposited, for I have bred the flies from blisters in the foliage of an umbellate species called "Alexanders," the *Smyrnium Olusatrum*.

A top-dressing of gas-lime, soot, wood-ashes, or lime, when the blisters are discovered, might be useful in destroying the maggots as they fall from the leaves to bury themselves, so that the pupæ would not hatch; or, if given immediately on the appearance of the first blisters, in all probability it would deter the flies from laying their eggs, and thus the evil might be evaded: but the most simple and certain remedy is the operation of pinching the blisters, which must destroy the maggots at once, and this could easily be accomplished by children, with a woman to see they did their work well. In any small plot or garden, an evening or two after work would be sufficient to insure their destruction.

When the parsnips are left for seed, the yield is often terribly injured and diminished by the larvæ of the little moths which infest the carrots, as we have already stated.*

There is also a species which, from its name, seems to be especially attached to the parsnip, yet I am not sure it may not be identical with *Depressaria*

* See pages 409, 410.

*Daucella.** It has been, however, described by Zeller and figured by Duponchel † as *D. Pastinacella;* and M. Zeller has reared many hundreds of the caterpillars, which live in July upon the flowers and young seeds of the parsnip. They are grayish blue, with the head, thorax, and pectoral feet black: upon each of the segments are six distinct little black dots, producing single minute hairs; the sides and the belly are yellow, and the abdominal feet are dotted with black. They sometimes eat into the stems of other plants, and there change to pupæ: they have been thus observed in the stalks of the common cow-parsnip, *Heracleum Sphondylium.*‡

15. *D. Pastinacella* has the head, palpi, horns, thorax, and the upper wings gray, more or less mingled with red, having broken longitudinal black lines corresponding with the nervures, and terminating at the extremity of the wing in little black dots or short lines: on the disk is a minute white dot elongated in the direction of the nervure and circled with black; cilia reddish; inferior wings ashy gray, very shining: the abdomen and legs of a similar tint: the wings expand about 11 lines.

It is an inhabitant of Bohemia and Austria, as well as of France. There seem to be no better modes of ridding parsnip crops of these caterpillar pests than hand-picking, and shaking the umbels over a gauze net, for the larvæ to fall into.

The last enemy of the parsnip to be noticed is the *Aphis Pastinacæ,* which is so similar to the turnip-leaf plant-louse,§ that I doubt if they be not the same.

16. *A. Pastinacæ* is yellow or green; the head, disk of thorax, and back of abdomen are black, as well as the horns, which are seven-jointed, but not long: the abdominal tubes are long and tapering: the wings are transparent, the nervures pale brown; the stigma is smoky green: the legs are ochreous, sometimes tinged with green; the hinder thighs are reddish brown at their extremities; all the shanks are black at their tips, and the feet are of the same colour: length, $\frac{2}{3}$ line; expanse, 3 lines.

This *Aphis* resorts to the parsnips in the beginning of June, but I have never known any fatal effects from its inroads, as amongst the carrot crops. The *Aphides,* however, which in the summer of 1847 smothered such a great variety of fruit-trees, shrubs, vegetables, and flowers, were congregated in countless myriads on the under side of the parsnip leaves, and there they died packed close together with their heads down and their wings a little elevated over their backs.

* See page 412.

† Godart, *Lep. de France,* vol. xi. p. 153, Plate 291, fig. 4, 5, *Hæmilis Pastinacella.*

‡ *Annales de la Soc. Ent. de Paris,* for 1844, Plate 6, b. § Chap. iii. p. 68.

SUMMARY OF THE FOREGOING CHAPTER.

Parsnips perhaps the best *substitute* for the *potato.*

Carrots subject to the *attacks of* a variety of *insects.*

The *carrot-leaf plant-louse killing* one-tenth of the *crops* about midsummer.

Powdered tobacco dusted over the carrots, or watering them with a *decoction of tobacco,* will *kill* the *Aphides.*

Another species of *Aphis* infests the *roots* in the autumn.

The *Rust* is occasioned by the *maggots* of a fly called *Psila Rosæ.*

These *maggots* infest the *carrots* in summer and winter, boring *labyrinths* round and through the *tap-root.*

They change to *pupæ* in the *earth,* and the flies are hatched in the spring.

Slugs and *Poduræ* also inhabit the unsound *roots.*

The *maggots of Psila nigricornis* are, probably, equally injurious.

Sometimes they attack the *carrots* when very *young.*

Remove the *infested roots* as soon as the leaves turn yellow, and *burn them.*

Trenching the ground in the autumn, one of the *best securities against* most *insects.*

A dressing of *spirits of tar and sand before sowing* has been successfully tried.

Pigeons' and *cow dung,* pointed-in at the time of sowing, will *secure the crop.*

Quicklime sowed and ploughed-in will *free the soil from maggots.*

Millipedes and *Centipedes* also infest the injured *carrots.*

The *Otter-caterpillar* of the ghost-moth will *devour carrots* as well as hop roots.

Draining is *circumscribing* the localities of many *insects.*

The *Swallow-tail butterfly* lays its eggs on the *carrot.*

The *caterpillar* feeds upon the *leaves,* also on the *rue, fennel,* and *marsh milk-parsley.*

The *common flat-body moth* lays its eggs on the *carrot flowers,* or in the axils of the leaves.

The *caterpillar* forms little cylinders of the *leaves,* which it also *eats.*

Solitary-wasps collect these *caterpillars* to feed their young.

The *caterpillars* change to *pupæ* in the *earth* or in the *rolled leaf.*

There is a *summer* and an *autumn brood.*

The *purple carrot and parsnip seed* flat-body *moth* is generated on the *wild parsnip.*

The *caterpillars* feed on the *flowers and fruit* in July and August, living in society.

They become *pupæ in the web* in *summer*, but in the *autumn* they are *transformed* in the *stalks.*

The *moths hybernate*, sheltering in thatch, outhouses, under loose bark, in chinks, under stones, &c.

If a few *parsnips* be planted amongst the carrots, the *caterpillars will resort to* the former and leave the latter untouched.

The *gray carrot-blossom flat-body moth* is *not abundant* in *England.*

The *caterpillars destroy* entire crops of *carrot and parsnip seeds* on the Continent.

They *live* in a *web* formed in the *umbels* which they devour.

Some change to *chrysalides there*, whilst others *bore into* the *stems.*

By *shaking* the *flower and seed heads* over a sieve the *caterpillars* may be *collected* and destroyed.

Hellebore powder, and perhaps *lime* and *soot*, dusted over the umbels, *would drive them away.*

They so greatly *prefer* the *parsnip* to the *carrot*, that the seed of these may be *preserved* by *planting some* of those *amongst them.*

The *parsnip heads* must then be *cut off* over a sieve and *burned.*

Two Ichneumons lay their eggs in the caterpillars, and their maggots *destroy them.*

The *carrot gall-fly* is bred from galls in the umbels of flowers.

The *galls* are probably the work of some *Cynips* or *Cecidomyia*, and the *Callimome Dauci* is most likely a *parasite.*

The *galls contain* little *orange maggots* in the autumn.

A fly (*Tephritis solstitialis*) is supposed to be attached to the *carrot.*

Parsnips get "rusty" in the spring, but do not suffer like carrots from this malady.

The *maggots* of *Psila Rosæ*, and probably *P. nigricornis*, infest them.

The *parsnip* and *celery miner* is a *maggot* living in *blisters* on the *leaves* in the summer and autumn, and has destroyed entire crops of the latter.

They change to *pupæ* either in the *blisters* or in the *earth.*

The beautiful *flies* are *hatched* in the *spring and summer.*

Alysia Apii, a *parasite*, lays its eggs in the mining maggots, and was bred in June.

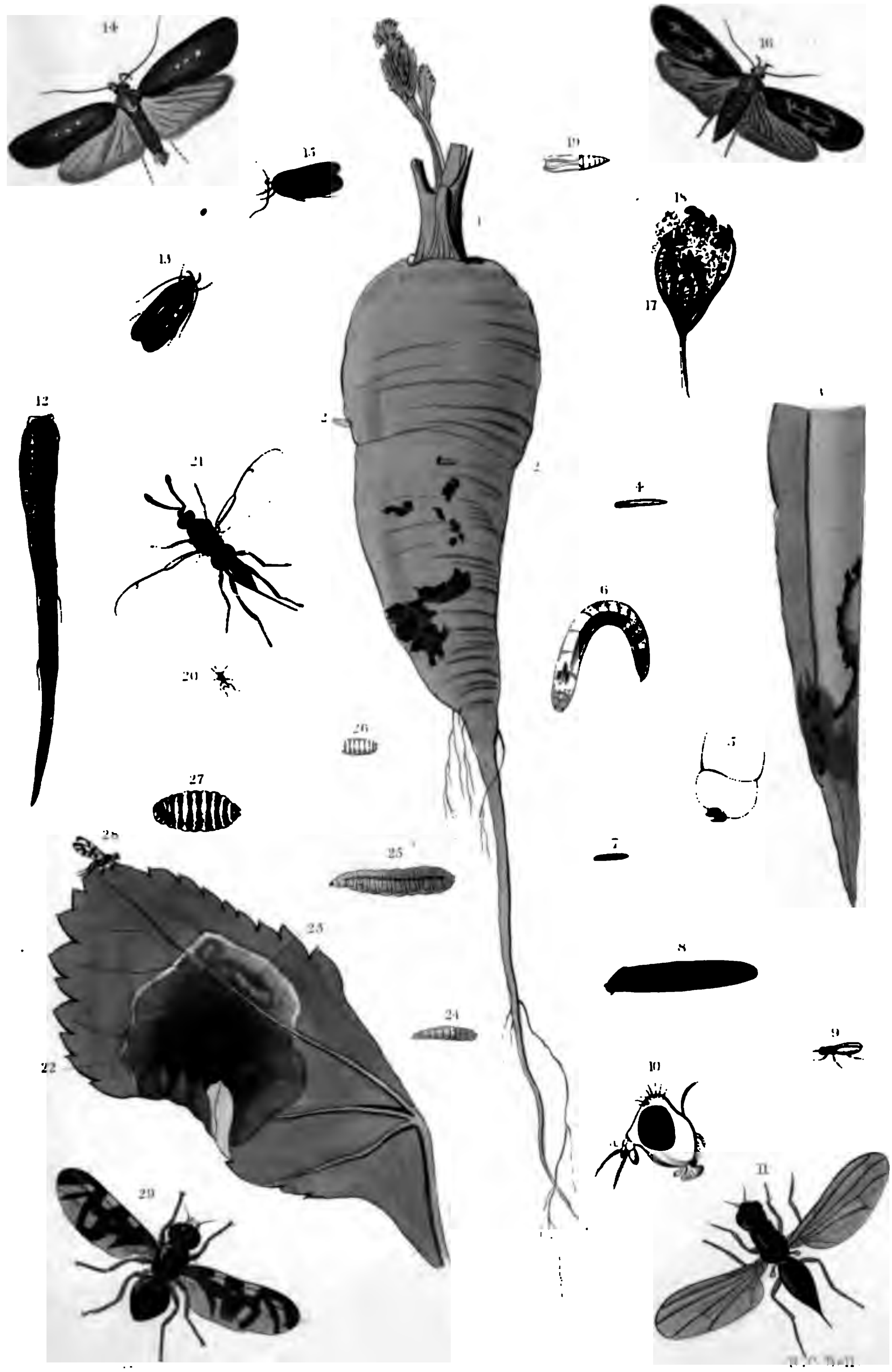
Pachylarthrus Smaragdinus probably *destroys* the direct *parasite* by laying its eggs in the pupæ of the *Alysia.*

The *mining maggots* may be effectually overcome merely by *pinching* the *blistered leaves.*

PLATE V.

CARROT AND PARSNIP CROPS.

Moths and Flies with their parasites affecting Carrot and Parsnip Crops



A *top-dressing* of *gas-lime, soot, wood-ashes,* or *lime* might kill the maggots when they bury themselves.

A little flat-body moth called *Depressaria Pastinacella* is bred upon the *parsnips.*

The *caterpillars* are very destructive to the *flowers and seeds.*

Hand-picking and *shaking* the infested *umbels* over a sieve to collect the *caterpillars,* are the best *remedies.*

The *parsnip plant-louse* is found upon the *leaves and flower-heads,* and it is closely *allied* to the *turnip-leaf Aphis,* if not identical.

Explanation of Plate N.

Fig. 1. A carrot-root affected by "Rust," and showing the mining of the maggots.
Fig. 2. The tails of the maggots sticking out, the heads being buried in the root.
Fig. 3. The root divided to show the depth of the injury.
Fig. 4. The larva of its natural size.
Fig. 5.* The tail, showing the two black spiracles.
Fig. 6.* The larva or maggot magnified.
Fig. 7. The pupa of the natural size.
Fig. 8.* The same magnified.
Fig. 9. The fly named *Psila Rosæ,* walking.
Fig. 10.* The head in profile, showing the eyes, mouth, &c.
*a,** The two drooping horns.
Fig. 11.* *Psila Rosæ,* female, magnified.
Fig. 12. A young carrot-root injured by the maggots.
Fig. 13. The moth, *Depressaria Cicutella,* at rest.
Fig. 14.* The same flying, but magnified.
Fig. 15. The male of *Depressaria depressella,* the purple carrot and parsnip seed moth at rest.
Fig. 16.* The female flying and magnified.
Fig. 17. An umbel of the flowers spun together by the larva.
Fig. 18. The caterpillar which spins the web.
Fig. 19. The chrysalis or pupa.
Fig. 20. *Callimome Dauci,* male.
Fig. 21.* The female magnified.
Fig. 22. A leaf blistered by *Tephritis Onopordinis.*
Fig. 23. The mining maggot under the skin.
Fig. 24. The maggot taken out.
Fig. 25.* The same magnified.
Fig. 26. The pupa.
Fig. 27.* The same magnified.
Fig. 28. The female fly, *Tephritis Onopordinis,* walking.
Fig. 29.* The male flying and magnified.

Those numbers with a * attached, refer to the objects which are represented larger than life, and all the figures are drawn from nature.

CHAPTER XV.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE POTATO CROPS, INCLUDING PLANT-LICE, PLANT-BUGS, FROG-FLIES, CATERPILLARS, CRANE-FLIES, WIREWORMS, MILLEPEDES, MITES, BEETLES, FLIES, ETC.*

THE disease† which has so seriously affected the potatoes since the year 1844, frequently rendering the crop worthless, and setting human ingenuity at defiance to discover a remedy, appears to result from atmospheric influence, produced probably by a succession of cold, heat, and unusual humidity, which did not agree with the constitution of this imported esculent. Amongst the numerous causes that have been assigned for the appearance of this alarming and severe visitation, insects have been frequently taxed as the destructive agents, but I am convinced the calamity is not to be attributed to their presence.‡ It certainly was remarkable that the *Aphides* should have swarmed in countless myriads in 1847, but the malady was not then so bad as it was in the previous and succeeding years, which appeared to me to be the most fatal to the potato crops; § yet, as far as my observations extended, the plant-lice were so scarce during 1846 that it was with difficulty I could find specimens, and I did not see a single *Aphis* upon my potatoes in 1848, notwithstanding the crop was worse than it had ever been before in my neighbourhood, more than half of them being rotten. The appearance of the *Aphides* in such unprecedented swarms may fairly be attributed to the same cause as the potato

* This chapter was written in 1849.

† Murrain, being "a plague in cattle," ought never to have been applied to the potato disease, as it frequently has been.

‡ M. Guérin holds a similar opinion, as well as Mr. Westwood and different members of the Entomological Society of London. See *Bulletin of the Royal and Central Society of Agriculture in Paris*, vol. v. p. 331, and *Gardeners' Chronicle*, vol. viii. p. 468. At German-Town, U.S., a weevil, named *Baridius trinotatus*, Say, *vestitus*, Schön, was observed to attack the potatoes to such an extent, as to lead to the belief of its being the real cause of the potato disease; but this beetle not being an inhabitant of Great Britain, it could not have caused the disease in this country.

§ The very great breadth of potatoes planted in 1848 has given so much larger an amount of produce, that the loss from disease is not felt as it would have been, had the usual quantity only been grown; and this is a very important fact to keep in view, as regards our future prospects. Indeed, is it worth while, *at present* at least, to sacrifice so many acres of valuable land in growing rotten potatoes?

rot—namely, certain conditions of the atmosphere; for it is generally admitted that the appearance of a species of insects in unusual abundance may be the effect either of some exciting influence, as electricity, or of a congenial temperature, creating a climate favourable to the increase of the animal, such as heat and moisture. In other instances it no doubt is owing to the absence of animals and parasitic insects in the previous year, whose province it would have been to keep within bounds these troublesome enemies to man.

If, however, the prevailing disease amongst the potatoes cannot be traced to the presence of insects, there is a large number of species which prey upon, and undoubtedly injure to some extent, the most healthy crops, and of these the history will now be given. It will be better to divide them into those which affect the foliage, and others which infest the roots, first in a sound, later in a diseased state.

APHIDES, *or Plant-lice.*

Many varieties of these insects are found upon the leaves of the potatoes during the spring and summer months, indeed so long as the foliage remains green and succulent. Their first appearance depends upon the mildness of the weather, for when it becomes cold they do not generate, or at any rate very slowly, so that the species disappear; but if a plant be taken and protected in a green-house or sitting-room, their economy is not interrupted even in the winter, as one sees by the pelargoniums being covered with *Aphides* when they are neglected. I have at this time (January) two tulips in a pot, the convoluted leaves swarming with *Aphides*, allied to the one infesting the peach-trees: the apterous females are daily bringing forth young, and the pupæ are hatching and producing winged females.* But to return: I very much doubt if there be any species exclusively attached to the potato, for the one named *Aphis vastator* by Mr. Smee, appears to me to be identical with my *A. Rapæ*, which inhabits turnip leaves, and was described and figured in chapter iii.†

In confirmation of my views I may state that, in April, Mr. F. J. Graham has detected the *Aphis Persicæ*‡ upon the potato leaves in his vinery; in the beginning of May, Mr. Denham found *A. granarius*, or an allied species, in some abundance on the potato leaves at Broxmouth Park. On the 5th of June, 1847, I observed upon my potato haulm the hop-fly (*Aphis Humuli*) and the turnip plant-louse (*A. Rapæ*); on the 13th, also, a species without honey-tubes; on the 17th, several belonging to a group separated from *Aphis* and

* Mr. F. Walker considers they are the *A. vastator* of Smee.

† *Gardeners' Chronicle*, vol. vii. p. 21.

‡ Curtis's *Guide*, Genus 1047, where nearly sixty species are arranged.

called *Schizoneura;* and in July, *Aphis Fabæ*, the broad-bean louse, was in some force upon the potatoes, whilst it was swarming upon other vegetables and garden flowers; for instance, the shoots of dahlias, the under side of the leaves of the convolvuli, French and scarlet beans, beet, and parsnips were literally covered and black with the winged females, sticking in closely-packed phalanxes, and in that position they died by the end of July or earlier—without killing any of the plants, to the best of my knowledge.

No one acquainted with cultivation will attempt to deny that the plant-lice have the power to destroy a crop—for instance, the horse and broad beans were a light crop, and entirely failed from the attacks of *Aphis Fabæ* in many districts in 1847; but in that very year the potatoes in gardens, where the *Aphides* were abundant, proved sound crops; whilst in 1848, where no *Aphides* could be found, the tubers were worse than at any former period. That *Aphides* will puncture the potato leaves there can be no doubt, and so incline them to wither; but there is no proof of their poisoning the sap and causing the rot. Indeed, it is only when plants are smothered with them, as we see beans, turnips, hops, and roses occasionally are, that their presence causes any real mischief, and then it simply arises from the local exhaustion produced by the abstraction of the sap from the leaves or young shoots, and of course when the circulation is impaired and the cellular tissue is deprived of its nourishment and dried up, the foliage becomes spotted and withers; but in no instance have I seen the *Aphides* on the *potatoes* in sufficient numbers to destroy the crop, or even to injure the produce.

The economy of the *Aphides* has been so amply detailed in a former chapter, that I shall now merely identify the species above noticed.

1. *Aphis Rapæ*, Curtis, chap. iii. p. 68.

Having received so many different species from various correspondents with the name of *A. vastator*, it is difficult to decide which is intended for the authentic one; but some which were stated to be typical examples, and identical with those figured and described by Mr. Smee, leave little doubt on my mind that they are the same as the *Aphis Rapæ*.

2. *Aphis Humuli*, Curtis, *Gardeners' Chronicle* for 1846, p. 405.

The winged specimens are exceedingly like *A. Rapæ* in size and colour.

3. *A. Persicæ*, Morren, is very like the preceding species, but it is rather larger, with much longer and slenderer ducts. In the autumn of 1834 prodigious swarms of this species were carried by a hurricane over many parts of Belgium.*

4. *A. Fabæ*, Scopoli. Chap. xii. p. 357.

* *Ann. Acad. Roy. des Sci. de Bruxelles* for August, 1836.

To render the history of this species more complete, the female and pupa are represented in our Plate O; figs. 1 and 3, magnified; figs. 2 and 4, the natural sizes.

5. *Schizoneura lanigera*, Hausen? belongs to a group which has been separated from the genus *Aphis* in consequence of the different neuration of the wings, &c. The winged specimens are only accidental inhabitants of the potato, and may frequently be observed on almost every plant in the garden. As a proof of the great fecundity of these insects, I put three from the potatoes into a quill, and in six hours they had produced forty-three young ones.

At the same time the natural enemies of the *Aphides* were not inactive: the lady-birds (*Coccinella 7-punctata* and *C. dispar*)* were laying their eggs, which soon hatched, and the little black larvæ made great havoc, as well as their parents, amongst the helpless communities: the beautiful two-winged flies (*Scæva balteata* † and *Cheilosia tæniata*) ‡ were also depositing their eggs beneath the potato leaves, where they soon hatched, and the maggots commenced feeding on their *Aphis* prey. These eggs are white, oval, and beautifully granulated, whilst those of the lady-birds are smooth, and of an orange or buff colour.

There are likewise some minute bugs and their larvæ, which are exceedingly serviceable in destroying the *Aphides;* and there seems to be scarcely a plant or tree where they may not be found: the perfect insects inhabiting the flowers, and the immature ones running about in search of the *Aphides*, which they transfix with their sharp rostrum.

These bugs are included in the Order HEMIPTERA, the Family COREIDÆ, and the Genus HYLOPHILA or ANTHOCORIS. The first species is called—

6. *H. Nemorum*, Linn.—It is only 1¼ line long: fig. 5; 6, the natural size. It is black and shining, the head is trigonate, narrowed before, with a three-jointed rostrum bent under the breast; the two globose eyes are prominent, and the two minute ocelli at the base of the crown are remote: the two horns are half as long as the body, straight, four-jointed, and black; first joint short, second the longest, bright ochreous, the tip black; third and fourth of equal length, the former ochreous at the base, the latter conical at the apex: thorax triangular, truncated before with two transverse channels: scutel triangular, acute, and not small: elytra elliptical, lying flat on the back, and extending beyond the abdomen, pale ochreous, with a spot at the suture, a bar or spot on the disk of each, and the oblique margin all fuscous; the terminal membrane is white, with a fuscous spot on the disk and a larger one at

* Chap. iii. page 72. † Ibid. p. 82. ‡ Curtis's *Guide*, Genus 1241, No. 3.

the tip: beneath are two transparent but iridescent wings, with a smoky spot at their tips: the six legs are bright ochreous and slender, the base and tips of the shanks, as well as the feet, are pitchy, and there is a ring of the same colour near the apex of the hinder thighs. It varies so much in the markings, that the different varieties have been described under the following five names by Fabricius, viz., *sylvestris*, *nemoralis*, *fasciatus*, *austriacus*, and *pratensis*.

They hide themselves when disturbed, often running into chinks in the bark of fruit and other trees, where probably the eggs are deposited; likewise under loose bark as well as in moss, where they hybernate, to come forth again in the spring.

The larva (fig. 7; 8, the natural size) is very minute at first, yet it resembles the parent in having a rostrum, horns, and six legs, but it is narrower, of a blood or chestnut colour, more ochreous when fasting, and it has no wings: the head is furnished with a very acute rostrum, longer than the head, the horns and legs are ochreous, the terminal joint of the former being the stoutest and of a blood colour. Fig. 9, the thorax and head nearly in profile. The pupa (fig. 10; 11, the natural size) is as long and broader than the perfect insect, which it greatly resembles in form, and it is equally active and useful: it is of a deep shining chestnut colour; it has no little eyes on the head; on each side of the back lies a flat rounded lobe, ochreous at the tip, and they contain the incipient elytra and wings: the body is broad, convex, and orbicular: the horns and legs are ochreous, the first and last joints of the former of a chestnut colour.

7. *H. minuta*, Linn., is a smaller species, being little more than 1 line long: fig. 12; 13, the natural size. It is shining black: the horns are brown, ochreous at the base: hinder part of the thorax punctured: elytra ochreous and punctured, the apex fuscous; membrane smoky on the disk: beneath them are two transparent wings: legs ochreous, tips of feet dusky. The larva and pupa are smaller than those of the former species, but they are equally beneficial, I believe, in preying upon the *Aphides*.

Flies, *or* Muscidæ.

Mr. E. Doubleday transmitted to me some flies which were stated to be laying their eggs in the young shoots of the potatoes, and causing the rot. They belong to the Order Diptera, the Family Muscidæ, and the Genus Sapromyza. The species has been named by Fallen—

8. *S. obsoleta.**—It is bright ochreous, producing a few long black bristles: the eyes have two purple lines when alive, but are brown when dead: the

* Curtis's *British Entomology*, fol. 605, and *Guide*, Genus 1295.

apical half of the third joint of the horn is black as well as the pubescent seta: the abdomen is rather small: wings ample, yellowish, and iridescent, but transparent; nervures ochreous: balancers with a large triangular club: legs whitish ochre; at the apex of the hinder shanks, where the spur is inserted, is a brown spot; the feet are dusky, the hinder thickened, especially the basal joint: expanse of wings, 5¼ lines.

The larvæ of most of the *Sapromyzidæ* are said to live in putrid substances, as mushrooms, &c., but Mr. Haliday has bred *S. rorida* from flowers.

Thrips.

In the summer of 1846 Mr. Barnes of Bicton,* and many other practical gardeners, entertained so strong a conviction that a little *Thrips* was the author of the potato epidemic, that I carefully investigated the subject, and was soon satisfied the disease could not be attributed to their agency. On the 30th of July, Mr. Barnes sent some diseased potato leaves with several of the little *Thrips* upon them. Being in Oxfordshire at the time, I immediately visited several allotments where I had observed the leaves and stalks were spotted. On digging up some of the worst, we found a *diseased* tuber of good size, and two more the following day. After a diligent search I detected the larva and pupa of the *Thrips*, as well as the perfect insects, amounting to about twenty specimens. The *Thrips* was most abundant where the plants were sheltered from the wind, invariably inhabiting perfectly healthy leaves; and on the following morning I could find very few. In another spot where the leaves were dead and the haulm spotted, we did not find one bad potato amongst those we dug up, nor a single *Thrips* on the green leaves of a few healthy-looking plants still remaining.

Various species of *Thrips* injure different crops of grain and fruit, as well as green-house plants, by abstracting the fluids which ought to sustain them, and so far the potato *Thrips* acts upon the leaves, but that has nothing to do with the rot in the tubers. When they congregate in countless myriads, as they often do in melon and cucumber frames, their presence is soon indicated by ochreous spots upon the cuticle, which end in the destruction of the leaf, arising from their puncturing it with their short beaks, and extracting the sap in the same manner as the *Aphides;*† but their number upon the potatoes was never sufficient to effect any important change on the constitution of the plants.

These minute creatures run with activity over the surface of the substances they feed upon, and no doubt the winged individuals can fly. The larva is

* *Gardeners' Chronicle*, vol. vi. page 532.

† See chapter x. p. 286, and Plate J and No. 38, figs. 8 and 9, *Thrips cerealium*.

shuttle-shaped and ochreous; the head is small and oval, with a minute black eye on each side, and a short beak beneath; the two horns are twice as long as the head, slightly pubescent and four-jointed; first two joints small, third egg-shaped, fourth nearly as long as the others united, ovate at the base and attenuated to the apex: trunk very long and broad, composed of three segments, the first trigonate with rounded angles, the two following forming broad bands; the abdomen is as wide as the thorax, composed of nine segments, conical and hairy at the apex: six short legs; thighs very short; shanks dilated; feet indistinct or wanting: fig. 14; 15, the natural size.

The pupæ are also ochreous, but before they change to the perfect state they become much darker; and being such atoms they are not easily detected under the leaves when at rest, lying close to the midrib or nervures, but they run about lively enough when disturbed.

They belong to the Order HEMIPTERA,* the Family THRIPSIDÆ, and the Genus THRIPS. The species on the potato was described by Linnæus a century back, under the name of—

9. *T. minutissima:* fig. 16; 17, natural size.—It is scarcely ½ line long; pale brown or dirty ochreous: the horns are short and six-jointed; the eyes are intensely black: the trunk is concave, and the sides parallel: the abdomen is oval, pointed, piceous, and shining: the four wings, lying parallel on the back, are narrow, dirty white, and ciliated: six short legs, stoutish and ochreous; shanks and feet simple.

SMYNTHURUS AND PODURA—*the Ground-fleas.*

In July and August numbers of these curious little creatures accompanied the *Thrips*, running and skipping about the under side of the potato leaves, often falling down upon their backs.

They constitute an order called THYSANURA, and belong to the Genus SMYNTHURUS. As I cannot find any description which entirely agrees with the potato species, I have named it—

10. *S. Solani.*—It is not bigger than a small grain of sand, and either entirely of a deep ochreous colour with black eyes, or as black as soot with ochreous horns: the head is large, like a great mask, and attached by a slender neck: the eyes are placed on each side of the crown; the horns are more than half the length of the body, slender, elbowed, and four-jointed?:† the trunk and body are united, forming a large globose mass, with a forked tail doubled under the latter for leaping: the six legs are rather short, and

* Mr. Haliday raised the *Thrips* to a distinct order, *Thysanoptera; Entomological Magazine*, vol. iii. p. 439, and Curtis's *British Entomology*, fol. and Plate 748.

† The terminal joint appears to be divided into six nodules.

apparently triarticulate: fig. 18, magnified; 19 is to show the leaping apparatus in another species.

These minute animals are nourished by eating the parenchyma of the green leaves, but some species feed on fungi. In Nova Scotia the crops of turnips and cabbages are principally destroyed, whilst in the seed-leaf, by some *Smynthurus*, the size of a pin's head, and nearly globular. It hops with great agility by means of its forked tail, and may be found on every square inch of all old cultivated ground, but it is not plentiful on new land. As these "ground-fleas" will not remain on damp ground, they may be expelled by sprinkling salt over the land after the seed is sown and well rolled down, or a thin layer of sea-weed spread over the drills is a perfect security against them.*

An allied genus called *Podura* has very lately been accused of being the origin of the potato disease. W. P. says—

"First, in an early stage of its existence, it lives on decayed vegetable matter, which it collects by burrowing into the earth; secondly, it occurs in numbers sufficient to cover nearly the whole surface of the earth; thirdly, it collects, as a means of existence, a substance which is poisonous to vegetables. It has power to infuse this into living plants by burrowing into the parenchyma. The poison is circulated through the system, vital action becomes suspended, mildew immediately follows, and in less than three days some of the plants attacked are dead vegetable matter, food for the offspring of the newly-discovered *Podura*." †

Dr. Lindley very justly adds, "Insects are not the cause of the potato disease."

CIMICIDÆ, or *Plant-bugs*.

It is somewhat remarkable that whilst portions of these creatures, as we have already shown, are destined to live upon *Aphides*, and so preserve our vegetables, others have an opposite taste, and, like the plant-lice, pierce the cuticle to feed upon the juices, causing similar injury by parching up the leaves, or covering them with blotches.

The appearance of various species of plant-bugs, their larvæ and pupæ, upon the potato crops, excited the attention of agriculturists, some of whom were at once disposed to attribute the prevalent disease to these insects. The truth is, when an unknown malady first visits us, it is natural that every one interested should endeavour to find out the origin, consequently every imaginary influence is taxed as the cause by the speculative mind; and from

* *Halifax Times.*

† *Gardeners' Chronicle*, vol. viii. p. 702.

the little attention that is paid by the farmer and gardener to the economy of insects, they are led to believe that certain tribes of animals are the culprits, because they chance to be abundant upon the plants, and they never observed them before; but if their attention had been directed to the subject earlier, they would in all probability have detected the same insects upon the same plants every year, in greater or less abundance.

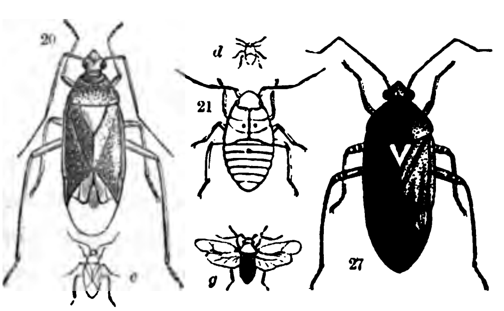
In July and August, 1846, I had numbers of specimens transmitted to me from Devon, Winchester, and various counties, the parties expressing a strong conviction that these potato-bugs were the cause of the disease. The cry was raised again in 1847, in the same months, which led to the subject being noticed in the *Gardeners' Chronicle.**

That these insects live upon the foliage of the potatoes there can be no question, and therefore it will be advisable to identify the species, so that at any future period no unnecessary apprehensions may be entertained should they appear in unusual numbers.

They all belong to the Order HEMIPTERA, the Family CORISIDÆ, and the Genus LYGUS or PHYTOCORIS. One species appearing different to any described, I have named it—

11. *L. Solani,* Plate O, fig. 20; *c,* the natural length: and No. 59, fig. 20; *c,* the natural size. It is green, shining, punctured, and clothed with soft depressed pale hairs: head small, smooth, transverse-oval, and ochreous; face triangular, with a long four-jointed rostrum bent under the breast in repose: the eyes are small, prominent, lateral, oval, and black; the two horns are ochreous, brown beyond the middle, long, very slender, angulated, and four-jointed, basal joint the stoutest, longer than the head, second twice as long, third longer, fourth shorter than the first. Thorax ochreous, convex, triangular, truncated before, twice as broad as the head at the base; scutel triangular: abdomen entirely green; the female with a channel beneath, inclosing the horny oviduct: elytra very long, elliptical, as broad as the thorax, resting horizontally on the back; stigma green, like the elytra; membrane transparent, iridescent, the nervures bright green: wings ample, transparent: six long, slender ochreous legs, hinder very long; feet ochreous, all

No. 59.



* Vol. vii. p. 468.

pitchy at their tips, and terminated by two claws; hinder thighs the stoutest, the shanks very long, slender and spiny: length nearly 3 lines. It is possible this species may be a variety only of the *Cimex pabulinus* of Linnæus, or the *Phytocoris prasinus* of Fallen.*

As soon as these insects leave the egg they can run about, being furnished with legs, horns, and a rostrum like the parents, but they are deprived of the organs of flight. As they grow they attain two lobes on the back, which inclose the future elytra and wings, and then they are called pupæ: Plate O, fig. 21; *d*, the natural length; and No. 59, fig. 21; *d*, the natural size. In every stage of their existence they feed in the same manner; but the perfect insects, which emerge from the matured pupæ, can fly well, are exceedingly active, leaping by short flights and tumbling about in the sunshine, so that it is difficult to capture these fragile creatures, especially without mutilating them. They were abundant from the middle to the end of August in 1846 and 1847.

12. *L. contaminatus*, Fallen, is very similar in size and form to the foregoing species: Plate O, fig. 22; 23, natural size; fig. 24, the head, &c., in profile. It is ochreous, the base of the thorax and the elytra inclining more or less to green, and the membrane is margined with a smoky colour; but it varies considerably, some having a dark spot at the base of the stigma, forming a bar across when the elytra are closed; the suture is also brown, as well as the nervures of the wings, and a patch on the back of the abdomen. It is 3 lines long: the wings expand 5½ lines.

This species was abundant on my potato crop in August, 1846, and it abounds on lime-trees from the beginning of May to the middle of August, or later.

13. *L. bipunctatus*, Fallen (fig. 25; 26, natural size), is a more robust insect. It is green, more or less ochreous when dead: the horns are stoutish, ferruginous, dusky at their extremity, with a pitchy spot beneath the first joint towards the base; the rostrum, in repose, extends to the hinder coxæ, and is pitchy at the tip. In some varieties there are two black dots on the disk of the trunk, and it is ochreous before: back of abdomen shining black, with the lateral margins pale: elytra with depressed black hairs, and generally with indistinct stripes or splashes of brick-red; membrane smoky: wings ample, smoky, with darker nervures: legs stoutish, especially the hinder; thighs ochreous, rusty at their extremities, tips of tibiæ and feet pitchy. Length, 3¾ lines; expanse, 7 lines.

This species was very abundant in the end of August, 1846, upon the potato

* Curtis's *Guide*, Genera 1100 and 1103.

haulm,* as observed by Mr. Balkwill and other gardeners. In summer it is often found on nettles in Ireland and England.

14. *L. umbellatarum*, Panzer (Plate O and No. 59, figs. 27; *g*, the natural dimensions), is a more oval species, with slenderer horns and legs: it is pale green or ochreous, shining, punctured, and pubescent: head smooth, inclining to red; horns rosy, tip of second joint with the two following brown: thorax rosy behind, and coarsely punctured, smooth before, with a transverse waved channel: scutel white, black at the base, sometimes with two longitudinal black or rosy lines next the thorax: body shining black above, margined with ochre: elytra elongate oval, clouded with red, the costa deeply notched at the base of the stigma, which is tipped with brown, the oblique and oval nervure scarlet; membrane with a smoky border and a dot within the cell; wings ample, iridescent, nervures dusky: legs ochreous, slender, and rather short, excepting the hinder pair; thighs with a reddish or brown ring near the apex, two rings in the hinder, the shanks spiny, all tipped with brown; feet pitchy. Length, 2¾ lines; expanse, 6 lines. This pretty species varies much, and some examples are very rosy.

At the commencement of September, 1846, it was abundant on diseased potato haulm in many localities. It inhabits grasses in May, and later in the year it is found upon the flowers of Umbellatæ. It is spread far and wide, for I have caught numbers in Scotland, especially in the isles of Skye and Arran.

Two other species, *Phytocoris pabulinus* of Linnæus, and *P. viridulus*, Hahn, are recorded as inhabiting and injuring the potato crops.† It is evident, by the following extract from a letter of a resident in South Australia, communicated to Mr. Thwaites, that the potato disease in that remote country, in 1847, has been ascribed to some insect allied to those infesting our own crops. The writer says:—"The fly which destroyed the potato crop was a small white *Tree-bug*, with transparent wings, not half the size of the common house-fly. They ate up all the tops of the potatoes, so that there was not a leaf to be seen, and of course the roots were useless where they attacked them in the early state." ‡

The following accurate observations of Dr. Harris will show that similar injuries were inflicted upon the potatoes in the United States ten years back, and that insects had been suspected of assisting in the destruction of the crops. He states that it was a species of plant-bug closely allied to *Phytocoris campestris* of Linnæus, and described as the *P. lineolaris* of Palisot de Beauvois, and the *Capsus oblineatus* of Say.

* *Gardeners' Chronicle*, vol. vi. p. 557. † Ibid. vol. vii. p. 468.

‡ *Transactions of the Entomological Society*, vol. v. p. xxxiii.

"During the summer of 1838," says Dr. Harris, "and particularly in the early part of the season, which it will be recollected was very dry, our gardens and fields swarmed with immense numbers of little bugs, that attacked almost all kinds of herbaceous plants. My attention was first drawn to them in consequence of the injury sustained by a few dahlias, marigolds, asters, and balsams, with which I had stocked a little border around my house. In the garden of my friends the Messrs. Hovey, at Cambridgeport, I observed about the same time that these insects were committing sad havoc, and was informed that various means had been tried to destroy or expel them without effect. On visiting my potato patch shortly afterwards, I found the insects there also in great numbers on the vines; and from information worthy of credit am inclined to believe that these insects contributed, quite as much as the dry weather of that season, to diminish the produce of the potato fields in this vicinity. They principally attacked the buds, terminal shoots, and most succulent growing parts of these and other herbaceous plants, puncturing them with their beaks, drawing off the sap, and, from the effects subsequently visible, apparently poisoning the parts attacked. These shortly after withered, turned black, and in a few days dried up or curled, and remained permanently stunted in their growth. Early in the morning the bugs would be found buried among the little expanding leaves of the growing extremities of the plants, at which time it was not very difficult to catch them; but after they had become warmed a little by the sun they became exceedingly active, and on the approach of the fingers would loose their hold and either drop suddenly or fly away. Sometimes, too, when on the stem of a plant, they would dodge round to the other side, and thus elude our grasp.

"I have taken this insect in the spring as early as the 20th of April, and in the autumn as late as the middle of October; from which I infer that it passes the winter in the perfect state in some place of security. It is most abundant during the months of June and July. It seems to be very generally diffused through the Union." *

Dr. Harris attributes the great increase of noxious insects to the exterminating war which has been wantonly waged upon the insect-eating birds. A hint, to place a hen-turkey or duck under a crate or cage, and let the young ones scour the garden, is worth attending to.

POTATO FROG-FLIES.

Equally or more abundant than the plant-bugs were these suctorial insects, which were hopping and flying over the potato grounds from the end

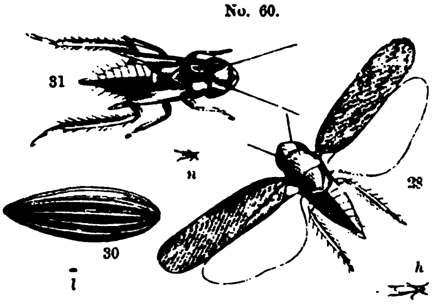
* Harris's *Treatise on Insects*, pp. 162, 163.

of August until the crops were lifted in the end of September. Every one has observed upon holyhocks and other flowers little patches of frothy matter called "cuckoo spittle:" they are occasioned by a tender little animal, which by sucking the plant buries itself in this froth, which protects it from heat and other inimical effects, until it is full grown, when it changes to a pupa, and from this emerges the perfect insect, called by Linnæus *Cicada spumaria.** The potato frog-flies are of the same family, only the larvæ do not secrete froth, but move about like their parents.

There are two species inhabiting the potato haulm: they belong to the Order HOMOPTERA, the Family TETTIGONIDÆ, and the Genus EUPTERYX.† One is closely allied to Fabricius's *T. flavescens*, which is larger, and, as I am doubtful of their being identical, I have named the potato species—

15. *E. Solani:*‡ Plate O, and No. 60, figs. 28, flying; *h*, natural dimensions. It is of a lively green colour, but fades after death to a yellowish green: the head is broad, short, and crescent-shaped above, with two lateral prominent brown eyes: Plate O, fig. 29, head, &c., in profile: the face is beneath, somewhat oval and very long, the apex producing a rostrum, and in a cavity on each side, before the eyes, are inserted the antennæ, which are short, and like two fine bristles, arising from two minute subglobose joints: the trunk is smooth, transverse, and semi-orbicular; the scutel is triangular, acuminated at the apex: the abdomen tapers to the apex, and is conical in the female, with a long and stout ovipositor beneath, formed of two sheaths, ciliated with hairs and inclosing the oviduct: wings four, lying over the back in a convex form, when at rest; the superior, called elytra, are twice as long as the body, narrow and elliptical, the nervures scarcely visible; they are very glossy and iridescent, the extremity rusty: inferior wings ample, nearly as long as the elytra, beneath which they are folded, being exceedingly delicate and iridescent: the six legs are very slender, the first pair are short, the hinder very long; thighs short and slender; the anterior shanks are armed with spines on the inside only and not to the apex; the hinder are long with a double row of spiny bristles on the outside; feet moderately long and triarticulate, basal joint the shortest, second the longest, but in the hinder pair the basal joint is the longest; claws and pulvilli minute. Length, 1 line; expanse, 2¾.

No. 60.



* *Tettigonia spumaria*, Curtis's *Guide*, Genus 1060, No. 6, and *Gardeners' Chron.*, vol. ii. p. 509.

† Curtis's *British Entomology*, fol. and Plate 640.

‡ *Gardeners' Chron.*, vol. vi. p. 388.

The females have been observed by Mr. F. J. Graham, depositing their eggs under the potato leaves: these are white, cylindrical, and somewhat shuttle-shaped, more pointed at one end than at the other, and striated with numerous furrows forming ridges; Plate O and No. 60, figs 30; *l*, natural size: the little creatures which hatch from them are green, with two horns and six legs, as well as a rostrum to pierce the cuticle of the plant. The pupa (figs. 31; *n*, the natural size) is green, and nearly as large as the parents, but narrower: the body tapers considerably: the head is broad, and the two black bristles forming the horns are much longer than in the perfect insect: it has two large black eyes: the stout rostrum lies under the breast, extending to the hinder hips: it is flexible and three-jointed, inclosing the four mandibles and maxillæ, which protrude beyond the apex like the finest bristles: the lateral lobes inclosing the future wings look like the pinions of a bird: it has six legs, the hinder pair being the longest. When these pupæ are full grown they attach their feet to the stalk or leaf, and by bursting the horny skin on the back, the perfect insect crawls out, and is thus liberated. These skins, as well as those cast off by the larvæ during their growth, are sometimes seen in multitudes adhering to the foliage or lying on the ground beneath.

The perfect potato frog-fly is often abundant from the middle of August to the end of September, when not unfrequently a dozen may be seen on one leaf. In dull weather they have a curious mode of evading notice by sidling round to the opposite side of the stem or beneath a leaf, but in bright warm days they leap and fly short distances.

The other species, which is equally abundant, has been named by Fabricius—

16. *Eupteryx picta:* Plate O, fig. 32; *m*, the natural dimensions. It is very similar in form to *E. Solani*, but it is larger and beautifully spotted: it is of a clear yellow colour, with two oval black spots on the crown of the head, and one on each side of the face, two larger ones on the trunk with two dots before, and two black spots at the base of the scutel: the abdomen is black, the margins of the segments yellow, the superior wings are clouded with brown, leaving the base, the tip, two large spots on the costa, and two on the suture, yellow, with smaller pale spots on the disk; inferior wings iridescent and transparent, the nervures brown: legs entirely of a sulphur colour. Length, 1½ line; expanse, 3 lines.

The pupa of this species is of an uniform buff colour: the eyes and tips of the feet alone being dark.

On the 19th of June, 1847, I first observed this species upon my potatoes, and in August they had increased greatly in numbers, the foliage being still green and healthy: they flew about a foot when disturbed, but did not leave the plants, alighting directly upon the leaves and sidling under them when alarmed. The pupæ were equally numerous under the leaves, with the exuviæ by them. This frog-fly also inhabits nettles, the burdock, and mint, and I have found it as late as November in gardens.

ALTICA.

In company with the foregoing insects was one of the *Alticæ*, or leaping *Chrysomelæ*. They first appeared about the middle of June, and they continued feeding until the leaves withered. During the whole of August, 1846, they were in multitudes on the bitter-sweet (*Solanum Dulcamara*),* a plant belonging to the same genus as the potato; the leaves of which they completely riddled. They are also abundant on grass till late in the autumn, but nothing is known of the larvæ, or where the eggs are deposited.

This beetle is comprised in the same group as the turnip-flies (*Altica Nemorum*),† but owing to the different form of the horns and feet, it has been separated from them. It belongs to the Order COLEOPTERA, the Family CHRYSOMELIDÆ, the Genus MACROCNEMA,‡ and appears to be the Linnean species §—

17. *M. exoleta*: fig. 33; 34, the natural size. It is oval, convex, shining, and ochreous: the head is black, with prominent eyes, two long clavate ten-jointed horns, two basal joints elongated, third a little shorter, the extremity dusky: thorax punctured, deep ochreous, transverse, slightly narrowed before, sides rounded; scutel minute: elytra pale ochreous, the suture pitchy; there are eight faintly-punctured striæ on each, and a short one on either side of the scutel; wings ample: under side pitchy: legs dark ochre; hinder thighs very thick and pitchy; the shanks rather short, the internal angle forming a curved lobe at the apex, which is cut off obliquely; feet four-jointed, third joint bilobed; hinder very long and inserted on the inside of the shank, basal joint as long as the others united: the apex furnished with two claws. Length, 1 line.

SPHINX ATROPOS—*The Death's-head, or Bee Tiger-Moth.*

Potato leaves do not seem very palatable to caterpillars, for, with the exception of two green striped ones and those of the death's-head sphinx, I do not know of any which feed upon them. The noble larva of this moth is occasionally abundant in potato grounds, sufficiently so lately to induce the

* Curtis's *British Entomology*, Plate 102.

† See chapter i.

‡ Curtis's *British Entomology*, fol. and Plate 486.

§ *Fauna Suecica*, No. 541, and Curtis's *Guide*, Genus 428, No. 10.

peasants in Kent to collect and give them to their poultry; yet thirty years back they were far from common, since *British* specimens of the moth were so much sought after by naturalists, that half a guinea was willingly paid for a fine native example. The unusual abundance both of the caterpillars and moths in 1846, was owing, it is presumed, to the high temperature in June and September, and it is not a little surprising that they should have escaped being included in the calendar with the other insects accused of destroying the potato crops; more especially as the moth bears a very bad character: even its name of "*Atropos*" is intended to imply its awful errand, as well as the familiar ones of Death's-head, *Tête de Mort*, and *Todtenkoph*, which it bears in this country, in France, and Germany, appellations derived from the image impressed upon its back; so that when *Atropos* intrudes itself into a dwelling amongst the rural inhabitants of the Continent, it causes no little consternation, since it is considered the messenger of pestilence and famine, if not of death. It is undoubtedly to be dreaded by bees, for it has the audacity to enter their hives and lap up the honey. It is from this propensity it has received the English name of "Bee Tiger-moth," and it is supposed to gain admission by imitating the note of the queen bee;* and being so thickly clothed with velvet over a horny case, it may laugh to scorn the stings of the bees.

This handsome moth is certainly a remarkable creature—it is so conspicuous from its size that no one can overlook it; for it is as big as a bat, the human skull depicted on its back is often very perfect, and it can utter a cry something like the faint squeak of a mouse, but more plaintive. The caterpillar rests like the classic Sphinx of Egypt, hence that distinction has been assigned to it, and it is very remarkable that an Egyptian mummy bears a great resemblance to the brown horny chrysalis.

It is not yet ascertained where the female moth lays her eggs; they must be as large as mustard seeds, and cannot be deposited upon the foliage of the potatoes by the autumn brood; indeed it has been ascertained that the females are then sterile. It is therefore quite possible that the eggs are generally laid by the earlier brood upon or under the potato leaves.

The caterpillars seem to have fed principally upon the leaves of the jasmine formerly, but I am not aware that they are found now upon any other plants in England than the potato, although they will live upon the bitter-sweet, tomato, thorn-apple, spindle-tree, elder, damson, and hemp. They come out to feed at night, and grow until they are nearly as long and as thick as a lad's middle finger, when they are of a yellowish or greenish tint,

* Reaumur, *Hist. Nat. des Insectes*, vol. ii. p. 289.

with seven oblique bands on each side, forming acute angles on the back; these stripes are blue, lilac, and white: the head is horny and furnished with strong jaws; it has six pectoral feet like claws, eight fleshy abdominal feet, and two similar anal ones, above which is a rough curled tail, and on each side are nine breathing pores called spiracles. When full grown the caterpillar buries itself in the earth, where, with a fluid from its mouth, and by the action of its head and body, it forms a smooth oval cell: having rested from this labour, it draws off its skin, and then is wonderfully transformed into a chrysalis or pupa, inclosed in a horny shell of a chestnut colour; the head blunt, the tail pointed, the eyes, proboscis, and wings being defined, and the body composed of several rings with breathing pores on each side, and if touched or breathed upon it wriggles its body to and fro. The first brood of caterpillars is thus transformed in July, and these produce moths in September and October, whilst those that arrive at perfection in the autumn do not hatch until the following spring. They were equally abundant in France in 1846, and there they remained in pupæ only three or four weeks.

The moth belongs to the Order LEPIDOPTERA, the Family SPHINGIDÆ, and was included in the Genus SPHINX, until it was separated from that immense family and received the appellation of ACHERONTIA. The species was named by Linnæus—

18. *A. Atropos.**—The wings sometimes expand five or six inches: it is densely clothed with short pile, like fustian: the eyes are large and prominent, and close to them at the back part of the head are inserted the horns, which are stoutest in the males, rather short, robust, and black, narrowed at the base, white and hooked at the tips: in front of the head are two erect palpi, and between them a short, stout, horny, black proboscis, which is rolled up spirally in repose: the thorax, as well as the head and superior wings, are black, with an ashy tint; on the former is an orange-coloured figure resembling a human skull, with the neck and collar bones: the abdomen is black with a grayish stripe down the back, and five or six long orange spots on each side, alternating with as many black bands: wings sloping (like the roof of a house) in repose; superior black minutely freckled with white, variegated with rusty patches, and several black transverse broken waved lines; one near the base, two others nearer the apex, and a spot on the disk, bright ochreous; inferior wings bright orange, with two black indented bars nearly parallel with the margin, which is formed of orange spots; the fringe of the wings is scarcely visible: it has six stout black legs, with two strong and distinct claws on each foot.

* Curtis's *British Entomology*, fol. and Plate 147, where coloured figures of the moth and caterpillar are given, as well as dissections.

Although the death's-head caterpillars either retire into the ground by day or otherwise secrete themselves, coming forth principally at night to feed, they are not secure against the untiring diligence of an ichneumon fly, which lays her eggs in the body of the larvæ, where the maggot hatches, grows to a large size, and changes to a pupa within its victim, from which eventually the parasite emerges instead of the moth.

It is the largest of our British *Ichneumons*, and is included in the Order HYMENOPTERA, the Family ICHNEUMONIDÆ, and the Genus TROGUS.* The species I named after the insect it was bred from—

19. *T. Atropos.*†—It is bright ochreous: head transverse with a black stripe on the crown, spreading along the base and terminating in a point on the face; eyes lateral, with three ocelli in triangle on the crown; antennæ black, the basal portion orange, long and setaceous, inserted close together near the middle of the face, composed of about forty joints, first joint the stoutest: thorax robust, oval, and black; scapulars, a line before them and a spot beneath, ochreous; scutel conical and yellow; postscutel rough with a shining knob at the base, and two elevated lines down the middle, forked at their extremities: abdomen long, elliptical, clavate, attached to the thorax by a clubbed petiole; slender at the base, sometimes with a black line beneath, seven-jointed, the four last segments black: wings ample, shining golden yellow, the hinder margins smoky, superior with a pentagonal areolet; stigma and nervures ferruginous: legs stout, first pair the smallest, hinder the largest: coxæ black; hinder thighs the thickest, black at the apex, especially beneath; anterior shanks short, hinder long, brown at the tips; feet longer than the shanks, five-jointed, terminated by two strong claws tipped with black, and dusky pulvilli between them. Length, 1 inch; expanse above 1¾ inch. The proportion of colour varies in different specimens, some have only a few orange joints at the base, whilst others are only black beyond the middle of the antennæ; a portion, or the whole of the fourth abdominal segment is ochreous, as well as the under sides of the coxæ, with no black at the extremities of the hinder thighs and shanks, in other examples.

My calendar is a proof of the abundance of the death's-head caterpillars in Kent, for I see that all my specimens of this *Ichneumon* were bred or taken at Rochester, Darent, and other localities in that county, I believe in July, one towards the end of that month; but it has been bred from other *Sphingidæ*, I have heard.

* Curtis's *Guide*, Genus 496, and Newport on *Ichneumon* (*Trogus*) *Atropos*, *Trans. Linn. Soc.*, vol. xxi. p. 85, pl. 9.

† Curtis's *British Entomology*, fol. and Plate 234.

ACARI, *or Mites.*

On the dead haulm of the potato these little creatures congregate for the sake of feeding upon the *Botrytis* or other fungi. One which Mr. Graham found in March, 1846, had been no doubt breeding through the winter, for they often generate in cavities under stones, and a larger and darker species resides in quantities under the tomato leaves in the autumn.

They belong to the Order APTERA, the Family ACARIDES, the Genus ORIBATES, formerly called *Notaspis*, and the potato species is named, apparently by Hermann—

20. *O. castaneus.*—It is as small as a cheese-mite, very glossy, pear-shaped, and of a rusty chestnut colour: the trunk is conical and conceals the head; it is distinctly separated from the body by a transverse channel; the latter is oval and dilated, being very convex, with a few long hairs scattered about: the eight legs are rather long and of a dirty ochreous tint, sparingly clothed with longish hairs, they are six-jointed; the hips and trochanters are short; the thighs are short and clavate, as well as the shanks, which have a little joint at the base; the foot is elongated but clubbed at the base, and terminated by a single long curved claw.

I have now to give the history of the second army attacking the potatoes, and which is unquestionably an enemy to the cultivator, for these insects subsist upon the tubers and roots, both injuring and reducing the crop.

The potato disease in France so greatly alarmed the nation on its first appearance, that Monsieur Guérin-Méneville was charged by the minister of agriculture and commerce to draw up a report, which was read before the Academy of Sciences in October, 1845, and afterwards published in one of the French Journals.* As M. Guérin has also been appointed by the government to investigate the origin of the disease in the silk-worm caterpillar, called *Muscardine*,† which is a species of fungus attacking living animals, his opinion becomes so important that I may be excused for introducing his observations before I proceed with my disquisitions. In addressing himself to the Entomological Society of Paris regarding "the malady which has for a long time spread itself over the potato crops," he says, "many persons attributed this epidemic erroneously to insects, whilst it is now demonstrated that it is produced by a malady of the plant, caused by colds which were felt at the end of the spring, and by the extraordinary humidity of the summer, which favoured the production of a cryptogame that developed itself in great numbers in every one of the cells of the potato. The insects and larvæ that have

* *Bulletin des Séances de la Soc. Royale et Centrale d'Agric.*, vol. v. p. 331.

† *Annales de la Soc. Séricicole.*

been found in spoiled tubers have come there when the potato has been partly decomposed by the fungi, and cannot be regarded as having caused the malady."*

Although I have discovered a great many insects affecting the tubers which are not recorded in M. Guérin's report, there are many no doubt which have not yet fallen in our way. I shall commence with those which live upon and of course injure the healthy and sound tubers. Amongst these are the—

SURFACE GRUBS.

In July 1844 I received some caterpillars from H. W. B., of Bedminster Lodge, near Bristol, stating that they were all taken on the 26th of July, from one plant in a field of potatoes: "They attacked the haulm just beneath the earth and ate through it. Acres of potatoes in this neighbourhood have been attacked by them. Some bore into the potatoes and destroy the small ones. They have also spoiled scores of celery plants and bored into the crowns of the carrots; indeed nothing seems to be free from them." They were the caterpillars of a moth, the *Noctua (Agrotis) exclamationis*, or *A. segetum*, which makes such havoc amongst the turnips, as before stated in this volume.†

TIPULÆ, *or Crane-flies.*

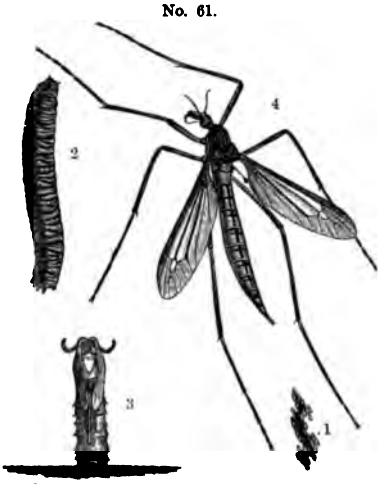
Any one may readily imagine what an amount of vegetation must be consumed by the maggots or larvæ of these gnats, seeing that during the summer and autumn it is not possible to step on a field or meadow without disturbing a family of the winged parents. Indeed, turnips, potatoes, beet, carrots, and cabbages often suffer as severely from the attacks of Surface-caterpillars, the larvæ of Crane-flies, and the Wireworms, as from any other insects.

From the beaked head and attitude of the body and legs in flight, the *Tipulæ* have been termed Crane-flies, but in some counties they are better known by the name of Daddy or Old Father Long-legs. As it is mostly in undisturbed ground that the larvæ are propagated to any extent, it is most desirable to keep land clean. Of course weedy banks and hedge-rows will naturally be a harbour for them, as they delight to live amongst the roots under tufts of grass, but their head-quarters are damp meadows and marshes. Wet, consequently, encourages them, and to drown them is impossible; therefore the opposite course, of draining land effectually, would no doubt annoy them more than any other process, and go far towards freeing arable lands, at least, from these universal pests.

* *Ann. Soc. Ent. de France* for 1845, vol. iii. p. lxxxvi. † Chapter v. pages 118 and 120.

The eggs are laid by the females, I apprehend, as they fly, or when they rest amongst the herbage, and are propelled as from a pop-gun. Those of *Tipula oleracea* are little oval conical grains, shining and as black as ebony; they form a mass occupying nearly the whole abdomen, and I have taken 300 or more from the body of one female: No. 61, fig. 1. The little maggots hatched from these grow until they are as thick as a small goose-quill, cylindrical, and about an inch long: fig. 2; they are then of an earthy colour and incased in such tough skins that they are called "Leather-jackets." The intestines shining through the back create two pale wavy lines, in which a pulse is very evident. When walking or wriggling along, for they have no feet, they protrude their little black horny heads, stretching out the neck, which then tapers, and exposing two minute rust-coloured horns and two strong black jaws; when in motion their tails are thickest and cut off abruptly, the edges above being furnished with four fleshy tubercles more or less pointed, with two below, and near the centre are two spiracles or breathing pores; they are composed of thirteen rings, and when drawn up and at rest look like small bots. From the beginning of May to the first week in August I have observed these larvæ at the roots of scarlet beans, lettuces, beet, and potatoes; and during the same period they are most unwelcome visitors in the flower-garden, where they commit dreadful ravages amongst the roots of dahlias, carnations, &c., and even the grass-plots in the metropolis do not escape, for in Golden Square a few years since the grass was laid bare by them. It is said they come out at night in multitudes to feed, and probably to remove from one locality to another when food becomes short, or it may be in search of convenient places to change into pupæ; at all events they are then secure from the rooks and smaller birds, which would speedily thin their ranks, and the dews cf night suit their purpose in every way better than the light and heat of day. Some of the forwardest change to pupæ early in August, perhaps in July, and certainly in September; this takes place under the turf, and even by the sides of gravel walks, if the weeds be left to grow: they are as long and thick as the larvæ, of a similar dirty colour, with two slender horns, one on each side of the head; the segments under the belly produce transverse rows of stout spines, and smaller ones on the back; the tail is pointed and spiny; on each side of the trunk are the

No. 61.



cases containing the wings, and between them those which enclose the legs. After remaining in this state a short time, the pupa, by means of these spiny rings, works its way through the surface of the earth, the horny covering of the trunk splits down the back, and the gnat crawls forth to dry its wings and harden its limbs, before it takes flight to pair and generate new families. At this time thousands of empty cases may be seen sticking half out of the earth amongst the grass: fig. 3.

The Crane-flies belong to the Order DIPTERA, the Family TIPULIDÆ, and the Genus TIPULA.* The species before us was named by Linnæus—

21. *T. Oleracea*, from its larvæ injuring cabbages.—It is of a tawny colour, with a bloom over it, giving the fly a dusty appearance. The head is small, almost globose, attached by a short slender neck, the nose forming a stoutish rostrum or beak, acuminated at the apex, and furnished with a short, fleshy, bilobed lip, and two longish five-jointed palpi; the eyes are hemispherical and black; the two slender horns are inserted in the face; they are as long as the entire head, tapering, and thirteen-jointed, the first longish, second globose, the remainder elongated and bristly:† trunk large, oval, raised considerably above the head, divided into three lobes on the back, which is brownish with obscure stripes; under side hoary, as well as the somewhat orbicular-quadrate scutel: body long, slender, and nine-jointed, clubbed at the extremity in the males, but it is much longer and spindle-shaped in the female, with the back slate-coloured; the apex horny, pointed, and furnished with two lateral tapering lobes, and an oviduct between them: two wings, longer than the body, spreading when at rest, rather smoky, with an areolet and seven cells at the apex; the nervures and a stripe along the costa, including the stigma, ochreous brown; two balancers, long, slender, and clubbed: legs six, slender, very long, especially the hinder pair, bright ochreous; tips of thighs, shanks, and the terminal joints of the tarsi brown; the claws are curved and acute, with minute pulvilli between them. The male is nearly ¾ of an inch long, and the wings expand 1½ inch; the female approaches 1 inch in length, and the wings expand nearly 2 inches.

There is another species so closely allied to the foregoing, that it is generally confounded with it: their habits and economy are similar, but they seem to be distinct, and it has been named by Meigen ‡—

22. *T. paludosa*, implying its partiality to marshy ground.—It is of the same size and colour as *T. Oleracea*, but the back of the abdomen is not of a slate-colour, the wings are shorter in the female, as well as her legs, which are also much stouter than those of the male: No. 61, fig. 4; the female.

* Curtis's *Guide*, Gen. 1160. † See Curtis's *Brit. Entom.*, fol. and Plate 493, for dissections.

‡ *System Besch. Europ. Zweif. Insecten*, vol. vi. page 289.

The males of the autumnal broods of both species first make their appearance about the commencement of August, and the females are abundant until they are killed by the frosts of autumn. Even in the chilly mornings of October they may be seen, half stupefied by the cold, hanging by their forefeet, their wings covered with dew, and lying flat on their backs, until warmed by the cheering rays of the sun the male takes wing, and the female drags her heavy body and long legs after her as she flies through the grass. The males are attracted by light, as I have seen great numbers come to a lamp at night in September, and the females have been observed at sea in calm weather many miles from land, standing on their legs, with the wings spread, sailing along unhurt. A few appear to be hatched in the spring, and no doubt there would be more, were it not for the larvæ furnishing rooks and many other birds with food during the winter and early spring. This is doing essential service, for in all probability these would produce the parents of the autumn broods, which, it is evident, are sufficiently numerous, notwithstanding the checks upon their multiplication.

Their numbers depend very much upon the seasons, and for this reason sometimes these troublesome larvæ are not seen. I believe they abounded in 1816–18, and then were lost sight of till 1829 and the two following years. In June 1845, they committed great havoc amongst some Swedish turnips in the Isle of Anglesea, upon an estate of A. Elliot Fuller, Esq. Wheat and oats are also laid under contribution by them. In the eighth volume of the *Gardeners' Chronicle,** there are some pertinent remarks by Mr. B. Maund, regarding the not growing of wheat after clover-lea, owing to the fly. He says:—

"My attention was called by an agricultural friend to an instance of this last spring, where it was discovered that the plant of spring-sown wheat was dying away, from its being eaten through just beneath the surface of the earth, and that the enemy was the larva or grub of a species of *Tipula*, or Daddy Long-legs. In some parts of the field these were so numerous just beneath the surface, that half a dozen or more could be collected within the space of a square foot; and such devastation had they made, that for half an acre together, in some parts of the field, very few plants of wheat were to be found. The field was rolled three times over in different directions, in April, with Crosskill's clod-crusher, and in a fortnight afterwards, the weather being dry, the land was almost as compact as a macadamized road."

This operation killed many, and saved the crop. Mr. Maund adds:—

"It is not unknown to farmers in the midland counties, that a crop of

* Page 707.

potatoes cannot be grown on some farms after clover, on account of the existence of this grub; and the only remedy adopted—a most efficient one—is breast-ploughing the turf and burning it."

From the immense swarms of a smaller species of *Tipula* on lighter arable lands, I am inclined to believe that the corn-crops suffer more from these than from the *T. Oleracea* on sandy and similar soils, and as I may not have a better opportunity of making this known to agriculturists, I shall not scruple to introduce the species here, especially as it attacks the potato likewise. The pretty gnat alluded to has been named by Hoffmansegg—

23. *T. maculosa.*—The male is not ½ an inch long; the female is more, and the wings expand about 1 inch. They are of a bright yellow colour, spotted with black: the *male* has a pair of slender blackish horns longer than the thorax; the forehead projects like a cone, on each side is a black dot, and on the crown is a black spot pointed over the forehead: the mouth is at the extremity of a cylindrical beak, the feelers blackish; the eyes are black, as well as three long patches on the back of the thorax, and various spots on the sides and beneath: the scutel has a conical mark on the back, with a black hinder margin: the abdomen is slender, the apex obtuse, with a broken line of eight black spots down the back; on the under side is a similar line, as well as several black dots at the base: the wings are smoky-yellow, and iridescent, with brown nervures, a yellow pinion-edge, and stigma; the two balancers are ochreous and clubbed: the long and very slender legs are ochreous, the extremities of the thighs, shanks, and the very long feet are black. The horns of the *female* are shorter: the abdomen is longer, spindle-shaped, with six distinct, black, top-shaped spots down the back, a row beneath, and several dots on each side: the horny ovipositor is ochreous and shining.

These gnats are abundant in fields, gardens, meadows, hedges, &c., during May and June. Sometimes they swarm on the sea-coast, and I remember once, in the middle of May, seeing myriads on the sand-banks in the Isle of Portland, also at the back of the Isle of Wight, and at Lowestoft in Suffolk. Many insects are driven apparently by the wind to the edge of the sea, where possibly their course is arrested by a sudden change in the wind, and they perish in the surf; but no doubt multitudes thus collected escape and generate in the surrounding country. There must be two or three broods of *T. maculosa* in a year, or else a constant succession of the flies during the summer, for although the month of May seems to be the period when the greatest numbers are hatched, I have bred them in July, but of course temperature has a great influence upon the pupæ.

I have not the least doubt that many different species of *Tipulæ* are bred in the field and garden, but the destructive maggots so greatly resemble each other, that they can only be distinguished by actual and careful comparison. A very similar larva is most abundant in the gardens of London, which produces an allied gnat, named by Meigen *Tipula quadrifaria*.

The eggs of *T. maculosa* are oval, spoon-shaped, and black as soot. They must be scattered over the ground as thick as poppy-seeds, for probably not one in a thousand arrives at maturity. The larvæ produced from them are of the same earthy colour as those of the Cabbage Crane-fly, but they are smaller, being only ¾ of an inch long, and as thick as a large crow's-quill; they differ also from them in the position and form of the spines; they are wrinkled, and when at rest contract themselves, drawing in the head and thoracic segments, so that this extremity might be taken for the anal end. They are, however, able to thrust out their heads and crawl along very well, although they are destitute of feet; the small brown head is furnished with a pair of black jaws, two short horns, and I believe minute feelers: three pale vessels traverse the sides and back, terminating in a truncated tail with two spreading hooks, and two short teeth between them, with two tubercles below, and two fleshy protuberances capable of dilitation and contraction, which materially assist the maggots in locomotion, and in the centre of the stern are two large spiracles. In the spring they change in the earth to pupæ of the like dirty colour; these are about the same length as the larvæ, but scarcely so stout. At this period the head and thorax of the future gnat are defined, but from each side of the latter projects a short slender horn, and beneath the horny case the incipient wings are visible, with the legs placed between them: the abdominal segments have each a transverse row of minute spines above, and five large ones beneath, and on either side is an elevated spiny line; the penultimate segment is surrounded by six longer spines and two small ones, with a large conical process at the tail and a shorter one beneath it.

To ascertain the parents of these grubs or maggots, I paid great attention to them for several years, and some idea may be formed of the mischief they occasion in the field, by the ravages they commit in the garden. On the 23d of April I found these grubs at the roots of my pease; on the 29th, some had eaten off trusses of the strawberry flowers close to the crown, retiring afterwards just beneath the surface of the earth, and I think it was the same, or the larvæ of *T. Oleracea*, which used to cut through the runners of the same plants: the first week in May they were not uncommon amongst the roots of the lilacs and under tufts of grass; they were also destroying the strawberry and raspberry plants as well as the carrots: on the 28th of the same month I observed some recently transplanted lettuces drooping, and on examination I found the roots separated from the crown a little below the surface, and close by these grubs, which are difficult to detect, owing to the colour and their remaining quite motionless when disturbed. At the end of July they were eating the roots of dahlias, carnations, and various flowers, and on the 7th of August they were observed infesting some potato ground with the larvæ of *T. Oleracea;* after which I lost sight of them.*

We learn from the *Introduction to Entomology,* that these larvæ abound in some seasons in Holderness to such an extent that hundreds of acres of pasture were destroyed by them in the spring of 1813. "A square foot of the turf being dug up, 210 grubs were counted in it;"† and wheats there when sown upon clover-lays suffer severely from these grubs.

Lime-water, it is now said, will not kill these tough larvæ, as it will the thin-skinned sensitive earthworm, and the only remedy I have practised with success has been to search for them round sickly plants and to dig up all that have been just eaten off by them. This must be done every morning, the earlier the better, otherwise the search may be unsuccessful, for after a short nap the culprit often decamps to feast upon some neighbouring plant. I should think water impregnated with brine, or nitrate of soda and perhaps strong liquid manure, would drive them off and keep the gnats from scattering their eggs in such an uncongenial locality; and if the maggots come out at night, as I have reason to believe they do, soot, sea-sand, and salt, sprinkled over the surface, would, I expect, destroy them; but it must be repeated to prove effectual.

Dickson advises, "When the grub is abundant, to roll the land betimes in the morning in the early spring months, which may crush and destroy them; and when the fly abounds in summer evenings on grass lands or fallows, rolling would destroy them and prevent the deposition of the eggs: they are chiefly deposited in the long grass, on sides of hedges and ditches: such places should therefore be kept free from weeds." He also recommends "keeping the clover stubbles closely eaten down by sheep or other animals, after the hay has been taken, till the wheat-crop is nearly ready to be put in, which has been found in some measure an effectual remedy against the destructive attacks of the insect."‡ Children and women might also be employed very advantageously in destroying the parent flies, by hand-picking and sweeping with nets. The farmer must also encourage such birds as render him good and constant service in reducing the insect tribes. Amongst them I shall ever believe that the rooks and starlings, seagulls and lapwings, are most faithful allies, and labourers worthy of their hire. I believe it was Sir Humphry Davy who first stated that jack snipes are very fond of the

* *Gardeners' Chronicle,* vol. vi. p. 317.
† Kirby and Spence, 6th ed. i. 148; 7th ed. 100.
‡ *Practical Agriculture,* vol. i. p. 555.

larvæ of *Tipulæ*, and Mr. Yarrell tells us he has repeatedly found them in their crops. Pheasants also must feed largely upon them in the winter, for Mr. Milton, of Great Marlborough Street, found in the crop of a cock pheasant, in December, 1844, 852 of these larvæ; they were alive, and nothing else was found in the crop, excepting a few oak spangles.* A correspondent also of the *Sporting Magazine* writes, "that no fewer than 1225 of these destructive larvæ (wireworms?) were taken from the crop of a hen pheasant in January." † No doubt these birds pick out the larvæ in corn and turnip fields, and when it is remembered, that the almost incredible numbers contained at one time in the stomach, only made a single meal, the extent of their services may in some measure be estimated.

WIREWORMS.

As no crop is perhaps altogether free from these destructive larvæ, we need not be surprised at their inroads upon the potatoes; indeed wireworms seem to be especially fond of them, since there is no better trap than slices of potato stuck in the ground and covered with earth, to be examined daily. In this way every wireworm may be attracted from a flower-bed and destroyed.

I do not apprehend that a potato-crop is ever entirely destroyed by wireworms, although when young they bore up into the haulm, as observed by Mr. Graham, and the sets also are stated to have been greatly injured by them in May; but they undoubtedly diminish the value of the tubers materially by perforating them, and thus rendering them a suitable nest for other insects. Towards the end of September, 1848, the potato crops in the parish of Hayes were greatly infested in some localities by wireworms, millipedes, and centipedes. A gentleman near Tadcaster‡ has suggested that potato crops may even attract the wireworm. It appears from our correspondent, that "in 1844, in order to clean and redeem seven acres of exhausted land, it was planted with potatoes after oats: the potatoes did not suffer from the wireworm, the crop was as good as could be expected, considering that the great dryness of the season had delayed the planting till June. In March, 1845, six acres were sown with oats, one acre having been dibbled with wheat in December. The crops were most healthy, but subsequently patches of decay attracted attention, and it was soon found that the wireworm had been at work to so fearful an extent, that in ten days the whole crop seemed victimized. Soot was then applied to four acres (sixteen bushels per acre), and not being able to obtain more, the remainder was sown broadcast with

* *Gardeners' Chronicle*, vol. iv. page 814. † Vol. iv. p. 45.

‡ The Rev. E. Duncombe, of Newton-Lyme.

guano, at the rate of two cwt. per acre, all applied in a pouring rain. This arrested the evil, and many of the patches apparently destroyed, struck up a second growth from about ½ an inch below the surface, where the wireworms had bored through the shoots, and the oats eventually became the best crop in the parish."

Mr. Duncombe also says—"On seeing the change for the worse in the oats, when averaging about six inches growth, I applied myself to discover the cause: I carefully removed the soil from very many plants and rows, for death seemed to go by rows for several yards together. I collected a paper full of wireworms, and uniformly found not a rotten but a dry mouldy potato or potatoes: some which were not so advanced were full of wireworms. Hence I conclude that the potatoes left in 1844 either bred or attracted from a distance these pests to my oats in 1845. If I had not planted potatoes in 1844, or if I had collected every one on taking up the crop (which I believe to be out of the question), I am fully persuaded in my own mind that I should have had no wireworm; and their numbers in the roots of anemones, on ground where I never can detect wireworms without such roots, induce me to incline to the opinion that gardeners and farmers cause the evil by neglecting preventives."

Here we have additional evidence of the taste which wireworms evince for potatoes. The tubers left in the ground attracted them to certain spots where they perforated the potatoes and caused their decay. If therefore these potatoes could have been collected before the oats were sown, the crop would have been saved from their incursions. When the first crop of oats was grown, they were probably too young to commit much if any apparent mischief, for I cannot think they came from any distance; if such were their habits, they must ere this have been observed when migrating at night. These remarks of Mr. Duncombe also show the value of soot in recovering crops from the attacks of the wireworms.

In the department of the Moselle, in France, wireworms are very common, and near Metz great numbers have been found by M. Rayer, the inspector of agriculture, both in sound and diseased potatoes.* It is worthy of remark that they are a very different wireworm to our common one,† being more like that of *Elater murinus* and *E. lineatus* of Bouché,‡ clearly showing that various wireworms feed upon potatoes, all of them making numerous holes and burrows in the tubers, both causing and hastening their decay.

Two chapters having been devoted to the wireworms, when the turnip crops were under consideration, with descriptions and figures of all the

* *Bulletin des Séances de la Soc. Roy. et Cent. d'Agric.*, vol. v. p. 331.

† Chapter vi. Plate F, fig. 2.

‡ Chapter vii. Plate G, figs. 40 and 42.

species, it is unnecessary here to enter further upon their economy,* and for the same reasons the false wireworms will not long detain us.

SNAKE MILLIPEDES

are found in large numbers in potatoes, as soon as symptoms of decay appear, especially in September, and they consequently complete the destruction which the wireworms began. *Iulus Londinensis* and *I. terrestris*† are two of the snake millipedes which are said to be injurious to early crops in the winter. During frosty and cold weather they lie curled up in the earth, but so slight a degree of warmth is required to awaken them from their torpor, that by merely breathing upon them for a few seconds they awaken from their slumbers, and move about with their accustomed gliding gait. They seem to congregate in autumn, and as they are very fond of fruit, vast numbers may be collected by putting slices of apples under tiles or in baskets of moss: upwards of forty have been taken from one slice: but these modes of catching them can only be practised in gardens; I expect, however, if cabbage leaves were scattered along the furrows in damp weather, that they would be nearly as attractive. The most abundant and mischievous species both in England and France is the *Iulus Pulchellus*,‡ called in some French works *Blaniulus*, from the indistinctness of the eyes or their entire absence. It was reported to have destroyed the potato-sets at Derby in April, 1845, and I have frequently found multitudes in partially diseased potatoes in the beginning of October, when they were generally accompanied by *Polydesmus complanatus*, which has also been figured and described in a former chapter.§

CENTIPEDES OR SCOLOPENDRÆ.

A large amount of these curious animals inhabit the earth, *Lithobius forcipatus* and *Geophilus electricus* (?) being the most usually met with. The former of these is said to be entirely carnivorous, and the latter will attack allied species as well as each other. Such being the case, they are probably useful in reducing the ranks of the various soft larvæ which affect the roots of plants. It is certain that they are very abundant in potato grounds, and Mr. Hope "attributed the potato disease to the attacks of the wireworm, and also to a small *Scolopendra*, which he had found in myriads infesting diseased potatoes at Southend." ‖ I observed them in rotten potatoes

* Chapters vi. and vii.

† Chapter vii. Plate G, fig. 54.

‡ Chapter vii. Plate G, fig. 53. Guérin considers this to be the *I. guttulatus* of Fab.; Supp. to his *Entom. Syst.*, p. 289.

§ Chapter vii. Plate G, fig. 55.

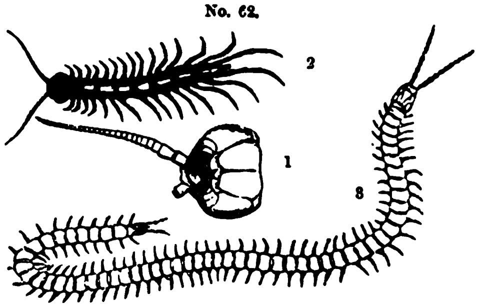
‖ *Transactions Entom. Society*, vol. v. p. 136.

in August, 1845; and in September, 1848, the *Geophilus electricus* was running about in every direction when the potatoes were forked out. Vast quantities of the sound tubers had been perforated by the wireworms, some of which were found inside, and the cavities were often enlarged by slugs.

These animals, which, like the millipedes, are not true insects, belong to an Order called CHILOPODA, and to the Family SCOLOPENDRIÆ. They were all included by Linnæus in the Genus SCOLOPENDRA, but from variations of structure one is now called—

24. *Lithobius forficatus, the thirty-foot.*—It is nearly 1 inch long and 1⅓ line broad; smooth, shining, horny, of a ferruginous or ochreous colour, sometimes brown: it has two longish tapering horns, composed of upwards of forty minute joints: the head is large and orbicular, armed with powerful jaws like a pair of claws, having a small group of granulated eyes on each side: No. 62, fig. 1 magnified; the body is flattened and linear, composed of sixteen plates like scales, alternately quadrate and narrow: it has fifteen pair of bristly and spiny legs, the hinder pair being the longest; they are seven-jointed, curved, tapering, and terminated by a minute conical claw: fig. 2.

No. 62.



The other species may prove to be the true *Scolopendra electrica* of Linnæus; it belongs to the Genus *Anthronomalus* of Newport,* and is certainly Leach's—

25. *Geophilus longicornis.*—This species is from 2½ to 3 inches long, and not more than ½ or ⅔ of a line broad. It is shining bright ochreous: the head is oval with a strong jaw on each side terminating in a sharp blackish claw: eyes none; horns thrice as long as the head, like two hairy threads, composed of fourteen joints, decreasing to the apex: body composed of a multitude of transverse segments, with from fifty-one to fifty-five pair of short legs, the hinder pair not longer than the others; the claws long and slender: fig. 3 magnified.

These creatures move with a very waving motion from right to left, doubling when they turn, and this, as well as a few other species, have the very extraordinary power of secreting a phosphoric fluid, which the animal leaves behind as it walks, so that when it is dark one sees a luminous broken line of light, sometimes two or three feet long. This phenomenon is generally noticed in autumn and spring, and is supposed to be most active when the

* *Trans. Linn. Soc.*, vol. xix. p. 430.

animals are pairing: whether the fluid is secreted by both sexes seems doubtful, and if they be quite blind, the light must be bestowed upon them for reasons which as yet remain hidden from us. Their economy is likewise very interesting, for Mr. Newport has proved that "the female deposits her eggs, from thirty to fifty in number, in a little packet, in a cell which she forms for them in the earth, and never once leaves them until the young are developed, which is at the end of about a fortnight or three weeks. During the whole of this time she remains in the cell, with her body coiled around the eggs, incubating them and constantly turning and attending to them." * They hybernate in the earth during the winter, and subsist partly on succulent roots, ripe fruit, and decaying vegetable matter, only coming out at night, apparently in search of food.

We have now arrived at the second section of our subject, relating to the various insects and allied animals which are found amongst the potatoes when decomposition has commenced. They amount to a very considerable number, and yet probably not half of them have been noticed, for whilst those recorded by M. Guérin comprise nine different sorts, the species detected in this country are twice as many.

In February, 1846, a *Podura*, probably the *P. plumbea* of Linnæus, was abundant, skipping about the rotting potatoes, with its beautiful iridescent scaly coat, and in the cavities were numbers of a milk-white ***Ricinus***, with multitudes of an ochreous *Acarus* allied to *A. coleoptratus*.† M. Guérin also describes and figures an *Acarus* called *Glyciphagus fecularum*,‡ and another which he names *Tyroglyphus feculæ*, § both of which were found in the changing potatoes or in cavities of the diseased tubers.

The species, however, which I found most abundant upon them, was the *Acarus farinæ*, which also swarms in meal and flour, when kept for any length of time, especially in damp places; and it is very remarkable that the same species seems to delight in worm-eaten wine-corks, for they have been sent to me from many cellars. In February, 1846, they were most abundant in decaying potatoes, and in March, 1847, they were observed by the Rev. L. Vernon Harcourt, near Chichester, and by Mr. Graham, of Cranford. Being very white, they may swarm, as they often do, in flour, before they are discovered, and no doubt they feed upon the starch and the farinaceous portions of the potato. The mites vary so greatly in their structure, that the old Genus *Acarus* has been split into many genera, and the one to which this species belongs is now called—

26. *Tyroglyphus farinæ*, being synonymous with the ***Acarus farinæ*** of

* *Trans. Linn. Soc.*, vol. xix. p. 428. † *Gardeners' Chronicle*, vol. iv. p. 316.
‡ *Bull. des Séan. de la Soc. Roy. et Cent. d'Agric.*, Pl. 5, fig. 7. § Ibid. Pl. 5, fig. 9.

De Geer.*—It is like a minute globule of fat, being of a pellucid shining white, with a rusty cloud on the back of some specimens, and it is not larger than a very small grain of sand: it is oval, the anus slightly concave; it has some longish rusty hairs scattered over the body, and the head and legs are of the same colour: the thorax is small and but slightly indicated; the head and mouth form a horny cone: the eight legs are short, stout, and tapering, the first and second pair incline forward, the former arise close to the head, the latter are attached to very large white scapes forming the base, the other two pair are inserted at the middle of the belly and incline backward; they are all six-jointed, the joints subquadrate or oblong, pilose, the penultimate producing a few long bristles and terminated by a strong hooked claw.

They walk with tolerable alacrity and delight to burrow head foremost into the flour. I have eaten pie-crust made of meal in which myriads of these mites were generating, and found no ill effects from the food. The meal was first spread on the top of an oven to dry, by which process I found that a small degree of heat killed them.

In the potatoes with the *Acari* were larvæ of various little beetles which assist in reducing putrid substances to a simple state, which is indispensable for supplying the soil again with the proper elements as food for the support of vegetation. One of them was very similar to the larvæ of a beetle called *Dermestes*, but only 1½ line long; another, a little larger, would undoubtedly produce some beetle of the Families *Carabidæ* or *Stapyhlinidæ*. A somewhat similar larva was found in France, which Guérin believes may belong to a Genus of little Rove-beetles,† called *Calodera*.‡ Another kind was detected by M. Rayer, which is likewise supposed to belong to one of the *Staphylinidæ*.

Nests, also, of little creatures were found in rotting potatoes, which looked like black mites, but on close examination they proved to be beetles —members of a family entirely devoted to the consumption of putrid animal and vegetable substances. I allude to the Family HISTERIDÆ; the species from the tubers belongs to the Genus ABRÆUS,§ and was named by Fabricius—

27. *A. minutus*.—It is a little oval, convex, shining beetle, like a seed, and not more than ½ line long, often only ⅓: it is of a dark chestnut colour: the head is bent down, the feelers being visible but not the jaws; and in front are two short, curved, eleven-jointed horns, terminated by a distinct somewhat oval club: the eyes are small and lateral: the thorax is very broad and punctured; the scutel is invisible: the elytra are broad, semi-oval, not cover-

* *Mémoire de l'Hist. des Ins.*, vol. vii. p. 97, Pl. 5, fig. 15.
† Chap. v. p. 138 and No. 25, figs. 3 to 6.
‡ Curtis's *Guide*, Genus 219[b].
§ Curtis's *Guide*, Genus 142, No. 2.

ing the rump; beneath them is folded a pair of wings: the six little slender legs lie close to the body in repose; the anterior shanks are flattened, and the five-jointed feet are short and very slender.

In the early spring these beetles are found under dung, and in September I have observed them in ripe and decayed cucumbers in frames, where sometimes they are generated in thousands, the warmth favouring their increase.

A still more minute beetle was detected amongst the potatoes, called *Trichopteryx rugulosa;* * it is not larger than this dot . being scarcely visible to the naked eye, nevertheless its pair of horns and six legs are complete, and the beautiful wings with a long fringe are most marvellously folded up under the wing-cases when not in use.

I have repeatedly found small Rove-beetles in the rotten potatoes, where I expect they live upon the *Acari* and minuter animals, but of this I have no evidence. Guérin likewise thinks it probable that their *larvæ* may live upon those found in the rotten portions of potatoes. One of the species is very widely spread in the autumn, and lives through the winter: it is named by Gravenhorst *Staphylinus nitidulus*, and is now called—

28. *Oxytelus nitidulus.*†—It is only 1¼ line long, narrow, flat, shining black, and coarsely punctured: the head is broad with several depressions, the oral organs are visible and the eyes prominent; before them are inserted the two horns, which are not longer than the thorax, thickest at the extremity, the first long and clavate, second small, third minute, the remainder like strung beads, increasing in size, the terminal joint ovate-conic: the thorax is broader than the head, somewhat semi-orbicular, with three channels down the back: the elytra are quadrate, chestnut-coloured, black at the base, and appearing striated from short depressed hairs: body nearly as long as the remainder of the insect, intensely black and glossy, elliptical, with seven distinct segments, the sides margined and pilose, the tail triangular: wings ample, folded beneath the wing-cases: six legs short and tawny; thighs thickened and rather pitchy in the middle; shanks flattened and serrated, excepting the hinder pair, which are slender; anterior notched outside near the apex; feet composed of three or four short and one long joint, with a pair of slender claws.

These insects are also found in decaying cucumbers, melons, and various vegetables; they frequent muck-heaps and breed in the dung of animals.

* *Bull. des Séances de la Soc. Roy. et Cent. d'Agric.*, Plate 6, fig. 3, and Sturm's *Deutsch Fauna*, vol. xvii. Plate 320.

† Curtis's *Guide*, Genus 216, No. 16.

Potato Flies.

Dead and silent as the earth appears to be, it teems with life; for not only is the soil full of seeds, which merely require light and heat to start them into life, but it must abound with the eggs of insects, so minute, that even with the assistance of a lens they escape one's notice. To be convinced of the truth of this, if a flower-pot be filled with mould from a field or garden, and then tied over with the finest muslin, the experimentalist will be astonished to find the multitudes of little flies which are constantly making their appearance, bred no doubt from larvæ nourished on the vegetable matter which such soils contain. Where crops are grown, and any portion of them becomes decayed, the number of these minute insects is vastly multiplied, and thus where the diseased potatoes have existed, additional swarms of various little flies have been the consequence. As a proof of the incredible numbers that must be thus generated, I may mention that from one growing and partially rotten potato I bred, in August, 1845, 128 flies, independent of many more which had died in the pupa state, or been destroyed by damp and mites before I discovered them in the vessel in which the tuber was placed, as well as multitudes of smaller flies, all of which I will now describe.

The whole belong to the Order DIPTERA: the first I shall notice is included in the Family TIPULIDÆ, and the Genus PSYCHODA, and has been named—

29. *P. nervosa.**—The males are twice as large as the females: they are ashy white, clothed with longish wool: the little head is buried under the thorax: the black eyes are large and lunate: the two horns are as long as the thorax, and composed of eleven (?) small joints, black at the base, giving them an annulated appearance: the abdomen is short and of a dirty colour: the two wings when at rest meet over the back slanting; they are iridescent, very large, oval, and lanceolate, with numerous longitudinal hairy nervures: the entire margin is also hairy; balancers small, clubbed, and white: six legs woolly; the feet five-jointed, the tips black. Length, $\frac{2}{3}$ line; expanse, 3 lines.

In February, 1846, the larvæ and pupæ were abundant in the rotten potatoes, also in decaying leaves and dunghills, and the flies have been bred by Mr. Haliday from putrescent fungi. These flies sometimes swarm in outhouses and about drains in spring and autumn.

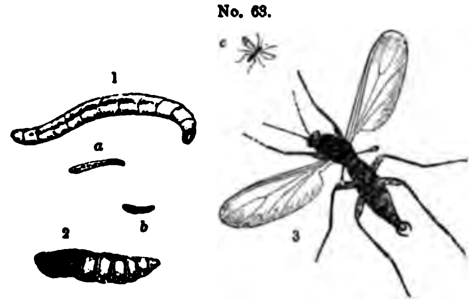
The larvæ are not $\frac{1}{2}$ line long, yellowish-white, cylindrical, spindle-shaped, with eleven distinct annulations besides the head, which is triangular; the tail is elongated and tubular. The pupa is about $\frac{2}{3}$ line long, ochreous,

* Curtis's *Guide*, Genus 1151, No. 6, and *British Entomology*, fol. and Plate 745. It is the true *Tipula phalaenoides* of Linnæus. See *Insecta Britannica*, vol. iv.

and ferruginous; it is elongate-ovate in repose, but the body can be stretched out and attenuated when disturbed: from the forehead project two slender appendages, like horns; on either side are laid the short stout antennæ, and the wings meet over the breast, with the legs stretched out between them: the abdominal segments are ciliated and the tail is forked.

Several species of a little swarthy two-winged fly were bred from the decaying potatoes in multitudes. They are called *Sciara* by Meigen, and *Molobrus* by Latreille. The larvæ I received from Mr. Graham: they are slender worms, about ¼ inch long, whitish and opaque, but when immersed in water they become perfectly transparent, exhibiting the ochreous viscera and the food digesting in the stomach; when in motion they taper towards the head, which is oval, horny, black, and shining; the body is composed of thirteen segments, with seven or eight spiracles on each side; the tail is broad and rounded, but slightly pointed in the centre: No. 63, fig. 1; *a*, the natural size. The pupa is shorter, cylindrical, elliptical, and of a dull ochreous tint, becoming darker as the period approaches of the birth of the fly: the antennæ, eyes, wings, and legs are visible beneath their horny sheaths: fig. 2; *b*, the natural size. At this period they are deprived of locomotion, but the larvæ, although perfect maggots, and destitute of feet, are able to move along in moisture, at the same time waving about and thrusting out their heads with great energy. There are thirty species of these flies which inhabit England, and three or four of them have been bred from putrid potatoes. One is called—

No. 63.



30. *Sciara fucata*, Meig.*—When alive it is 1 line long: fig. 3; *c*, the natural length. The *male* is of a pale inky black, the head is small and spherical, with two triarticulate feelers bent under; the two horns are not longer than the thorax, tapering, pubescent, inserted in front of the face, and sixteen-jointed, two basal joints the stoutest, the remainder oblong, apex conical: eyes lateral, kidney-shaped, and coarsely granulated; ocelli three, but unequal: trunk gibbose, subquadrate, scooped out at the base, with two indistinct lines of short ochreous hairs down the back; scutel lunate, postscutel oval, of a grayish colour: abdomen slender, greenish black, brownish after death, seven-jointed, the margins of the segments pale, apex obtuse, and furnished with two incurved biarticulate lobes: two wings,

* Meigen's *Syst. Besch. Europ. zweif. Inseck.*, vol. i. p. 280, No. 6; and *Gardeners' Chronicle*, vol. v. p. 784.

incumbent in repose, parallel, longer than the body, iridescent, slightly smoky, but transparent and clear at the base; nervures brown, excepting the central one, which is scarcely visible, but forked and dark at the margin; the costal nervure does not reach the base of the forked cell: balancers pale dirty yellow or ochreous: six legs, long, slender, and of a dirty yellow or pale olive tint. *Female* similar, but larger, being 1½ line long, the wings expanding nearly 3 lines: the thorax is not narrowed behind: the abdomen is spindle-shaped, attenuated, and conical, terminating in two little parallel sheaths: the two balancers are dusky when dry.

This was bred in the winter of 1845–46, and again in 1848, in vast quantities: the flies are also found throughout the summer in fields and gardens, on umbellate flowers, and on grasses. I have likewise bred them from rotten turnips in March.

31. *S. quinque-lineata* of Macquart* is 1⅓ line long. "It is black with five lines on the thorax of a deep dull gray: anterior hips testaceous: wings almost hyaline:" balancers brown or dirty white.

Specimens agreeing with this description were bred from rotten potatoes in March, 1848, and sent to me with the tubers containing the larvæ and pupæ also. The potatoes were like old rotten cheese, and portions of the outside were covered with slimy threads, which Mr. Graham saw the larvæ spin. He thinks they cause the "scab" in potatoes, but I saw not the least vestige of the insect on one variety of my potatoes, which was very scabby.

32. *S. pulicaria?* Meigen,† Hoff., is ⅓ a line long or upwards, and is distinguished from the two foregoing species by its longer antennæ, which are equal in length to the rest of the body. "It is black, with testaceous legs: the wings almost hyaline: balancers brown."

My specimens being as big again as Meigen's, with ochreous balancers, I am doubtful if they be the *S. pulicaria* of that author. I bred them in August, 1845, from a rotten potato.

Another dipterous insect was bred from the potatoes in less quantities. It also belongs to the Family TIPULIDÆ, and the Genus SCATHOPSE. It appears to be Meigen's—

33. *S. punctata.*‡—It is black and shining: the head is small; the eyes are kidney-shaped, with three little ocelli on the crown; the antennæ are short, stout, cylindrical, and composed of eleven cup-shaped joints: thorax elongated and somewhat compressed, with a white dot on each side; scutel small

* *Hist. Nat. des Ins. Diptères*, vol. i. p. 149, No. 10.

† *System Besch. Europ. Zweif. Inseckten*, vol. i. page 282, No. 12.

‡ Ibid. vol. i. p. 301, No. 4, and Curtis's *Guide*, Genus 1177, 3.

and rough; abdomen broad, oval, and depressed: wings ample, resting horizontally, transparent, and iridescent, with a black costal, subcostal, and basal nervure, the first and second united beyond the middle, and divided near the base, by an oblique nervure; there are also four other very faint longitudinal nervures, the apical one forked, the anal one waved: balancers yellowish: legs simple, longish, and rusty; extremity of thighs and shanks variegated with fuscous; feet brown, five-jointed, terminated by a pair of minute claws. Length, 1¼ line; expanse, 3½ lines.

The larvæ from which these flies proceed, live in various putrid substances, and even in dung: they have also been bred from the cocoons of silkworms, in all probability containing decomposing caterpillars or rotten pupæ; they are from 2 lines to nearly ¼ inch long, flat, and narrowed at both ends, of a dirty grayish-yellow colour; the head is brown and oval, with two short feelers: the body is composed of twelve pubescent segments, the first thoracic one with a prominent spiracle on each side, as well as the penultimate, which with the apex is covered with radiating bristles. The pupa is 1½ line long: it is inclosed in the skin of the larva, a little depressed, and yellowish brown: from the thorax projects a branched spiracle, like a buck's horn, and the tail has a stout spine. It remains from a week to a fortnight in this state, and the flies are often exceedingly abundant in the autumn.

Two large species of flies belonging to the Family MUSCIDÆ I also bred from a single potato, as previously stated. There were forty-eight specimens of one which was named by Fallen—

34. *Musca stabulans.**—The *male* is 3½ lines long, and the wings expand ½ an inch: it is of an ash-colour, and clothed with black bristles; the feelers are ferruginous; the antennæ drooping, five-jointed and rust-coloured, pitchy at the base, third joint elliptical and hoary, except at the base; the seta black and feathery, the basal joint minute: eyes large, approximating, naked, and chestnut colour, the margins silvery white, as well as the face, with a black stripe tapering from the antennæ to the three ocelli on the crown: thorax hoary, with four black longitudinal stripes before, the two central ones the longest, with a spot on each side, beyond the centre; scutel hoary, with a dark stripe at the base, ferruginous at the tip: abdomen ashy-ochreous, shining, the back variegated with brown patches: wings with the apical cell not angulated, but suddenly rounded, scales at the base with pale tawny margins, and concealing the ochreous clubbed balancers: legs black, apex of thighs and tibiæ ferruginous; pulvilli at the extremity of the feet elongated. *Female* similar, but the eyes do not approximate, the face has a yellow tinge, and the stripe

* Meigen's *Syst. Besch. Europ. Zweif. Inseck.*, vol. v. p. 75, and Curtis's *Guide*, Genus 1286, No. 23.

on the crown is broad and elliptical: the abdomen is broader, with an oviduct at the tail, and the pulvilli are small.

The maggots had bred and accumulated amongst the slimy matter of the rotting potato just as meat-maggots are found, together with the horny pupæ. Indeed, the largest maggots were exceedingly like those of the flesh-flies, being fat and whitish, the ochreous food and white lines of viscera shining through the transparent skin: the head was pointed with a black proboscis formed of two horny claws, and the two spiracles at the blunt tail were like two black horny knobs. The tough and oval pupæ were of a bright chestnut colour, the segments slightly marked, the head end rounded and wrinkled to a point, the tail furnished with two black spiracular tubes.

Of the other fly I bred fifty-eight specimens from the same potato in the middle of August. The larvæ escaped my notice at first from being so very like the earth in colour, and they are still more difficult to detect from their sluggishness. They must be in the greatest force in July, but I have met with them in rotten potatoes in the end of November The group of flies with these singular spiny larvæ have been formed by Bouché into a genus called HOMALOMYIA,* being a section of *Anthomyia*. The parent fly of our species is exceedingly like *Musca canicularis*† of Linnæus; still there are differences, and as the larvæ are also dissimilar, I have named this Potato-fly—

35. *Anthomyia tuberosa.*‡—The *male* (No. 26, fig. 8; 9, natural dimensions; p. 143) is 2½ lines long, and expands 5½: it is grayish-black and bristly: the eyes are chestnut colour, naked, approximating on the crown, the inner margin silvery white; antennæ drooping, five-jointed, third joint oblong, fourth a slender elongated basal joint to the longish pubescent seta; thorax with five indistinct broad stripes down the back, second and third abdominal segments with bright ochreous spots on each side, third rarely with two similar minute spots: wings transparent, nervures dark, the two transverse ones not very remote: balancers pale tawny: legs black, base of shanks indistinctly ferruginous. *Female* ashy slate colour: the eyes smaller than those of the male and remote; the face not silvery: thorax with five distinct broad blackish lines down the back: abdomen ovate-conic, with two indistinct ochreous slightly diaphanous spots on the second abdominal segment; in other respects this sex is similar to the male.

The larvæ, although indolent, can crawl well; they are of a dull tawny colour, clothed with long bristly spines, somewhat depressed, elliptical, tapering to the head, which is waved about, and when thrust out is whitish and fleshy, armed with two minute hooks like ebony, and there is a little fleshy

* *Natur. der Inseckten*, p. 89.

† Curtis's *Guide*, Genus 1287, No. 104.

‡ *Gardeners' Chronicle*, vol. v. p. 817.

horn on each side; on the following segment is a spiracle on either side, surrounded by several stout short rays; the two next segments have tubercles on the back; the remainder have a double series down the centre producing bristles, with a double row on each side, and eight of the segments have a pair of short spines on each beneath, which enable it to walk; the apex is armed with six long bristles a little spiny at the base, but most of the others are naked, or with the slightest appearance of pubescence or little spines at the base; on the apical segment are two spiracular tubes: No. 26, fig. 6; 7, magnified; page 143. The pupa being formed within the indurated skin of the larva, it varies from it only in being more convex above, and the fly escapes by a lateral opening in the thorax.

These larvæ and pupæ I find occasionally in my garden where cabbages have long occupied the ground, and Dr. Harris remarks that the hairy maggots of *Anthomyia cunicularis*, or an allied species, live in rotten turnips;* they also abound in privies, and the pupæ cases are sometimes found in multitudes under the boards.

From the large quantities of these maggots which have been ejected from the human stomach and intestines, accompanied by the most distressing symptoms,† I am led to conclude from their economy, that the eggs or larvæ are conveyed into the stomach in badly or half-cooked vegetables, for it is evident they subsist upon decomposing vegetables and excrementitious substances, and I have found similar but very small larvæ on cabbage-leaves in October. It is therefore very probable that, under certain morbid conditions of the constitution, they are able to live in the human body until they have arrived at their full growth, when they are necessarily ejected to become pupæ, and after a short time to be transformed into flies. It is not a little remarkable that the maggots of *Musca stabulans* should have been also voided from the intestines,‡ and that fact tends to substantiate the view I have taken of the subject, and the cause of their presence in the human system, for that is the other species of large fly which I bred from maggots generated in the same potato.

I also detected the larvæ and pupæ of a smaller species of fly called *Drosophila*, which hatched in the middle of August with the foregoing insects. They are also inhabitants of cellars, as their specific name implies, where the larvæ are usually very abundant all the year round. They will breed in stale beer, and probably are generated where there is any leakage from the

* *Treatise on Insects injurious to Vegetation*, p. 414.

† Iliff, in *Lancet* for July 25, 1840; *Transactions Entom. Society*, vol. ii. pages 152 and 256, Plate 15, fig. 19; *Memoirs of Med. Soc. of London*, for 1789, vol. ii. figs. 1–4.

‡ *British and Foreign Medical Review* for April, 1842.

tap and oozing about the bung, as well as from the fungi which spring up round rotten wood, &c., in cellars. I have also known them to be bred from vinegar,* and it will be remembered that one species, *D. flava*, lives on the pulpy substance of the turnip-leaves,† and another, *D. graminum*, I have bred from cabbage-leaves. In spring and autumn the flies abound, and are not unfrequently on the inside of our windows. They belong to the Family MUSCIDÆ, and the Genus DROSOPHILA. That bred from the potatoes appears to be the Linnean species named—

36. *Drosophila cellaris*—It is 1½ line long, and expands 4 lines: the general colour is ochreous: the head is broad as well as the face, in the centre of which are inserted the two little drooping pubescent horns, the third joint is oval, and from the back arises a feathery bristle jointed at the base: the orifice forming the mouth is very large; eyes large, hemispherical; ocelli three on the crown; thorax globose-quadrate; scutel semi-ovate: abdomen small, depressed, oval, blackish, and six-jointed, with four or five ochreous bands; the apex pointed in the female: wings incumbent in repose, very long and ample, yellowish and iridescent, with a very short marginal cell, and four longitudinal nervures, the second and third united towards the base, the third and fourth towards the margin; balancers small, clavate: six legs tapering: feet long, slender, and five-jointed, terminated by minute claws.

The larvæ are 2½ lines long, of a whitish colour, tapering towards the head, composed of twelve joints; on each side of the thoracic segment is a short branching spiracle, and the tail is furnished with four divaricating blunt spines, the edges of the segments being serrated with hooked ones. When full grown, this skin becomes horny, changing to a rust colour, the maggot is transformed to a pupa within an internal horny shell of a chestnut colour, and of course the pupa greatly resembles the larva.

There is also an extensive group of flies called *Borborus*,‡ the larvæ of which live upon decomposing vegetable, and probably animal substances also: at all events they are generated in fungi. A portion of these flies is now distinguished by Macquart under the generic name of LIMOSINA;§ one of them I have bred from rotting potatoes, and it seems to be identical with that author's—

37. *L. geniculata.*‖—It is only 1 line long, and expands a little more than 2 lines. It is black; the head is moderately large, with an ample cavity beneath to receive the mouth: the eyes are hemispheric and rust-coloured, and there are three minute ocelli on the crown; the face is concave, with two

* Curtis's *Brit. Entom.*, fol. and Plate 473, and Curtis's *Guide*, Genus 1334.

† Chapter iii. page 84, Plate C, fig. 5.

‡ Curtis's *British Entom.*, fol. and Plate 469.

§ Curtis's *Guide*, Genus 1350.

‖ Macquart's *Hist. Nat. des Diptères*, vol. ii. p. 572.

little horns in the centre, the third joint orbicular, with a tomentose seta: thorax broader, very convex; scutel semi-orbicular and flat: abdomen very short, the segments equal in length: wings rather small, smoky, nervures pitchy; costal the strongest; submarginal cell not extending to the apex, second and third longitudinal nervures united at the middle, third and fourth forming a loop with two minute branches at the extremity; balancers small and ochreous: legs pitchy; hips ochreous, as well as the tips of the anterior thighs and the base of the shanks; hinder with a few spines outside; feet long, five-jointed, especially the hinder, which are slender and longer than the shanks; dull ochreous, basal joint very long and pitchy, terminal one very short, and furnished with short claws.

M. Rayer also observed a species in the infected potatoes which has been named by Guérin *Limosina Payenii*,* and it is not improbable that it may be the male of Macquart's species, for it agrees very well with our female, except in the colour of the wings and the structure of the hinder feet.

With the foregoing *Diptera* I often bred a parasitic insect in considerable numbers, but to which it is attached, or whether to any of them, I am unable to ascertain. It belongs to the Order HYMENOPTERA, the Family PROCTOTRUPIDÆ, and the Genus CERAPSILON, which has been divided by Mr. Westwood into three Genera, one of which is called *Paramesius*,† and to that section our insect belongs. It is included by Nees ab Esenbeck in the *Genus Diapria*, and has been named by him—

38. *P. brachialis*.‡—The *male* is scarcely 1 line long, and expands 1⅔; it is very glossy black; the head is globose; the face short, ovate, and at the bottom are attached the antennæ, which are nearly as long as the body, ferruginous, and fourteen-jointed, basal joint long, second short, obovate, third notched or comma-shaped, remainder short and obovate, apical joint conical; eyes small, lateral, with three ocelli on the crown in a triangle: thorax very globose, scarcely larger than the head: scutel small, semi-oval, deeply hollowed at the base; metathorax ferruginous and uneven; petiole forming a ferruginous knob, woolly behind; abdomen small, ovate-conic, pitchy, base ferruginous, with four longitudinal channels on a very large segment, apical segment very short: four wings dusky and pubescent, with a few nervures at the base of the superior, forming an elongated cell: six legs short, slender, and ochreous, pitchy at the base; thighs thickened, as well as the anterior shanks, and pitchy at the middle; feet slender, five-jointed, tips dusky. *Female* above 1 line long, and expanding 1¾: this sex is not only distinguished by its larger size, but the horns are shorter, with

* *Bull. des Séances de la Soc. Roy. et Cent. d'Agric.*, vol. v. Plate 6, fig. 4.

† Curtis's *Guide*, Genus 571.

‡ *Hymenop. Ichn. Affin. Mon.*, vol. ii. p. 333.

only twelve joints, the third being simple like the second; and the extremity of the abdomen is acuminated, and very acute.

This insect belongs to a family which is very serviceable in keeping down wireworms and other subterranean larvæ, as will be seen by a reference to a former chapter* and the *Gardeners' Chronicle.*† Nees also says that the *Diapriæ* breed in the subterranean larvæ of *Tipulæ*, or Gnats.

I must not omit to record another fly called *Dilophus febrilis*, which is exceedingly abundant every year, the larvæ causing much mischief in gardens; and at the close of the year 1845 many of them were sent to me as abounding on decayed portions of planted potatoes, and I have met with them likewise about the tubers and in flower-pots, where they burrow in all directions. Some I received in July were about ½ of an inch long, of an ochreous brown or snuff-colour, and shagreened: the back is slightly convex, with twelve well-defined wrinkled segments and a horny shining head, much narrower than the body, intensely black or inclining to chestnut-colour, and slightly hairy; there are eight distinct spiracles on each side, the penultimate segment is rounded, with four teeth on the margin, and the anal one has four smaller teeth, with two large spiracles near the base: it has no feet.

They were transformed to pupæ in the earth in the beginning of August, and were then yellowish-white; the thoracic portion was very thick, with two horns in front; the body slender and subcylindric, the segments very distinct, with spiracles down the sides, and the tail spiny.

The flies hatched on the 21st of August, but they abound in fields, hedges, especially under trees, and even in the highways around London, the whole of that month; and there must be two broods of them, as they are found likewise in May. They belong to the Family TIPULIDÆ, and to the Genus DILOPHUS. The species was named *febrilis* by Linnæus, from the generally received opinion in Sweden of these flies resorting to houses where intermittent fevers existed.

39. *D. febrilis* is intensely black, shining, and hairy. The head of the *male* is hemispheric, and covered with large densely pubescent eyes of a reddish-brown colour; there are three minute ocelli forming an elevated triangle near the base: the lip is broad, and the feelers incurved: the trunk is oval and gibbose, with two transverse rows of minute teeth before: the scutel is short and broad: abdomen sublinear, eight-jointed, the apex clubbed: the two wings are incumbent in repose, perfectly transparent and white but iridescent, the pinion only is slightly tinged with brown, the costal nervures pitchy, the others very faintly marked; a radial nervure uniting with the

* Chapter vii. page 198, Plate G, figs. 46 and 47, the pupa, I expect, of a *Proctotrupes*.

† Vol. vi. p. 36, *Proctotrupes Viator*.

costa at the middle forms a brown spot at the extremity: two balancers, with a large compressed brown club: it has six long legs; anterior thighs the thickest, the shanks very short, the apex surrounded by a coronet of teeth; there are also several short spines outside; feet slender, five-jointed, terminated by claws and suckers: length, 2½ lines; expanse, 5 lines. The *female* is larger and very different, the head being much less, with small oval eyes not meeting on the crown: the abdomen is brownish and elongated, ovate at the extremity but narrowed at the base, and the tip is furnished with two minute tubercles: the wings are much longer and very ample, entirely brown, the pinion being the darkest, with a brown stigmatic spot; all the nervures are pitchy; the anterior thighs are incrassated.

These insects fly heavily, their hinder legs hanging down, and in the evening they become sluggish, resting on herbage and bushes. The larvæ also inhabit cow-dung and horse muck: it is therefore very possible they may be introduced into potato-grounds with the manure, or the flies may be attracted to highly manured ground to deposit their eggs; for so little is known of the economy of many insects, that it is impossible to determine their exact habits: indeed no description or figures were to be found of the larvæ and pupæ of this fly, until I sent them to the *Gardeners' Chronicle.**

FALSE SCORPIONS.

These singular little creatures have occurred in some numbers amongst decaying potatoes, where probably they live upon the mites, as one species is known to be very serviceable in keeping under those pests in cabinets of natural history; others are found attached to the legs of house-flies so firmly that it is scarcely possible to remove them, but whether they destroy the fly, or only avail themselves of their power of flight to be carried from one locality to another, is not known. These false scorpions belong to an Order called by Latreille TRACHEARIÆ, to the Family CHELIFERIDÆ, and the Genus CHELIFER. I can find no description which answers to this species correctly: it is undoubtedly closely allied to Hermann's *C. nepoides*, but the inequality in the length of the legs seems to distinguish them, and for that reason I shall call the potato species—

40. *C. inæqualis.*—It is ¾ of a line long, of a lively rust colour: the head is pointed; the two little eyes are scarcely visible; the feelers are like the claws of a crab, as long as the body, smooth, with scattered hairs, and four-jointed; the basal joint is short, hatchet-shaped, second twice as long and oblong, third as large, pear-shaped, fourth the largest, oval, terminated by two

* Vol. iv. p. 868, with figures of the male, female, larva, and pupa.

long slender claws, forming pincers; thorax oval, with a transverse suture across the middle: body oval, and brown with scattered hairs, furnished with eight shortish, ochreous, shining legs; four first the shortest, five-jointed, and terminated by a minute double black claw.

Worms.

It may be remembered that in discussing the minute animals which affect the wheat crops, a very remarkable little worm called *Vibrio tritici* was described and figured,* and its history was also detailed. It appears that M. Rayer has discovered a similar species which breeds in multitudes in rotten potatoes; and the same animals were observed by Mr. Graham and myself in March, 1848, in myriads in the putrescent tubers. This Vibrio is named by Guérin, *Rhabditis tuberculorum*, and is shorter and stouter in its young state: the tail of the male is rounded, conical and pointed in the female: the mouth is furnished with two rounded nipples, and a third between them connected with the œsophagus, and the body is devoid of articulations: it is not thicker than the finest hair, and scarcely visible in repose. As it is well figured, with dissections, in the bulletin so often referred to in this chapter, it is unnecessary to comment further upon this worm at present.

I am not aware that snails injure the potato crops at any period, but slugs do much mischief to the late crops, enlarging the holes perforated by wireworms, snake millipedes, and other subterranean animals, which is one good reason for lifting the crop as soon as the tubers are ripe, to prevent unnecessary waste. This reminds me of a singular fact recorded in a useful monthly publication called the *Farmers' Herald.*† A bag was found in a cooked potato, containing eleven white globular pellucid eggs, scarcely so large as mustard-seeds: they were a little pointed at one end, and had every appearance of having been laid in the cavity by a slug, which is exceedingly probable, as I have found them half concealed in potatoes, where they had feasted so long and increased so greatly in bulk, that it was impossible to withdraw them without enlarging the orifice.

I believe this may close my observations regarding the insects and small animals which directly or indirectly injure the potato crops. They amount to sixty or more, but probably their name would be "Legion" if we were thoroughly acquainted with all the species, in their different stages of development, preying upon this useful esculent; and although in the foregoing pages no attempt has been made to give undue importance to their agency, there can be no question that insects often injure the potato crops to a great

* Chapter x. page 299, No. 41, fig. 2.

† Vol. iii. p. 139.

amount. Indeed, as we have endeavoured to show in this volume, their mission is to labour in the destruction of vegetable and animal matter, and consequently there is not a crop in the field and garden that, sooner or later, is not subject to their ravages.

SUMMARY OF THE FOREGOING CHAPTER.

Aphis of potato, the same as that on the turnip, named *A. Rapæ*, and identical with *A. vastator.*

Various species of *Aphides* are found upon potato haulm, as *Aphis Rapæ*, *A. Humili*, *A. Persicæ*, *A. Fabæ*, and *Schizoneura lanigera.*

It is only when the *plant-lice* take possession of a *plant*, breed upon and *smother* it, that they can *affect its life.*

It is by *suction* they exhaust vegetation.

Lady-birds and their *larvæ*, the *maggots* of *dipterous flies*, and some small *bugs*, *live upon* the *plant-lice.*

A fly called *Sapromyza obsoleta* supposed to cause the *potato rot*, laying its eggs in the young shoots.

Thrips minutissima accused of causing the *potato epidemic.*

They live by *suction* and *never* are in *sufficient numbers* upon the potato leaves to *affect the tubers.*

A ground-flea, *Smynthurus Solani*, feeds on the pulp of the leaves.

A *Smynthurus* in Nova Scotia *destroys* the very young *turnips and cabbages.*

They generate upon *old cultivated ground*, and damp drives them away.

Salt or *sea-weeds* scattered over the ground will *expel them.*

A *Podura* feeds on the pulp of the leaves, and is supposed to *poison the sap.*

Plant-bugs believed to cause the *potato disease.*

Lygus Solani, *L. contaminatus*, *L. bipunctatus*, *L. umbellatarum*, *Phytocoris pabulinus*, and *P. viridis*, were the accused species.

Another species appeared ten years earlier in the *United States*, where similar opinions were entertained of their *poisoning the potatoes.*

Frog-flies, called *Eupteryx Solani* and *E. picta*, breeding on the potato haulm, and accused of destroying the potato crops.

They live by suction, as well as the *plant-bugs*, from the time they are hatched to their final state.

Macrocnema exoleta, a leaping beetle, feeds upon and riddles the leaves of the potato and bitter-sweet.

Caterpillars of the *death's-head sphinx* feed upon *potato leaves.*

This *moth robs bee-hives*, and is called also the *bee-tiger*.

Trogus Atropos lives in the *caterpillars* of the *death's-head moth*.

Oribates castaneus congregates on the *dead potato haulm* to feed on *fungi*.

M. Guérin attributes the *potato disease* to *atmospheric changes*, and *not to insects*.

Surface-grubs, the caterpillars of moths, *Agrotis exclamationis* and *A. segetum*, destroy potato as well as turnip crops.

Maggots of Tipulæ, the *crane-flies*, seriously affect the *potato crops*.

They revel in *damp and undisturbed land: draining* is therefore *obnoxious* to the *Tipulæ maggots*.

The eggs are scattered among the grass and weeds.

The *larvæ* of *Tipula oleracea* and *T. paludosa* are living *from April to August*, and destroy turnip, potato, beet, carrot, and cabbage, as well as corn crops, and injure pastures and garden plants.

These *gnats* are most abundant *from July to November*.

Wheat cannot be grown after *clover-leas*, owing to the *maggots* of the *Tipulæ* and the *wireworms*.

Repeated *rollings* with Crosskill's clod-crusher, or *breast-ploughing* the turf and *burning* it, are the best *remedies* against the maggots.

Larvæ of *Tipula maculosa* injurious to *corn and potato crops* on *light lands*, and very destructive in *gardens* in the spring and summer.

These *gnats* abound in *May and June*, when the *eggs* are *laid*.

Watering with *salt or nitrate of soda* would free the land, as well as *searching* round sickly and dying plants *early in the morning*.

Repeated dustings of *soot, sea-sand*, and *salt*, would probably *destroy* the *maggots*.

Rolling grass at the proper season will *destroy* the *gnats*, and prevent the deposition of eggs.

Clover-stubbles should be kept *close fed* by sheep, &c., as it is an excellent *remedy*.

Rooks, starlings, sea-gulls, lapwings, snipes, and *pheasants*, consume immense quantities of *subterranean larvæ* or grubs.

Wireworms drill potatoes in the summer and autumn, if not earlier.

Potatoes when left in the ground *attract* all the *wireworms*, as will sliced potatoes when covered with earth.

Oat crop saved by sowing *soot* and *guano*.

A different species of *wireworm destroys* both *sound* and *diseased potatoes* in France.

Snake millipedes assist in *destroying potato crops* on the first appearance of disease.

Iulus pulchellus is the most *abundant* and *mischievous*.

Centipedes in abundance in *potato grounds*, especially *Lithobius forcipatus* and *Geophilus electricus?*

They are said to be *carnivorous*, and *G. electricus* leaves a *train of light* as it walks.

Podura plumbea? in abundance about *rotting potatoes* in February.

A *Tick*, and three mites, named *Acarus coleoptratus? Glyciphagus fecularum*, and *Tyroglyphus feculæ*, inhabit the *decaying tubers*.

A mite, *Acarus farinæ*, also swarms in the spring in *diseased potatoes*.

They *love damp*, and a small degree of *heat* will *kill them*.

Three or four different *larvæ*, the produce of little *Rove-beetles*, &c., which probably feed on the mites, are generated *in decomposing potatoes*.

A Rove-beetle, called *Oxytelus nitidulus*, is a constant inhabitant of *decomposing vegetables*.

Nests of little beetles, *Abræus minutus*, in *rotting potatoes*.

Trichopteryx rugulosa, one of the minutest of beetles, also resides *in diseased potatoes*.

A little gnat, *Pyschoda nervosa*, bred in multitudes from *rotten potatoes* in the *spring*.

The flies, *Sciara fucata*, *S. quinquelineata*, and *S. pulicaria?* hatched in multitudes from the same *tubers* which supplied food for their *maggots*.

Scathopse punctata? another small fly was bred with them.

Forty-eight examples of a large fly, *Musca stabulans*, were bred from a single potato in August, and

Fifty-eight of another fly, *Anthomyia tuberosa*, from the same rotting tuber.

These and a closely allied species are produced from *maggots* which are occasionally *voided* in vast quantities from the *stomach* and *intestines of man*.

Are they not *introduced* into the *stomach* with *badly cooked vegetables?*

Drosophila cellaris, the Cellar-fly, also came forth from the *same potato* as the last-named flies.

Limosina geniculata is another fly I have hatched from *putrid potatoes*, and *L. Payenii* also in France.

A *parasitic* fly, *Paramesius brachialis*, is often bred where the foregoing *flies* are *generated*.

Larvæ of a fly, *Dilophus febrilis*, also infests the *tubers* in the ground.

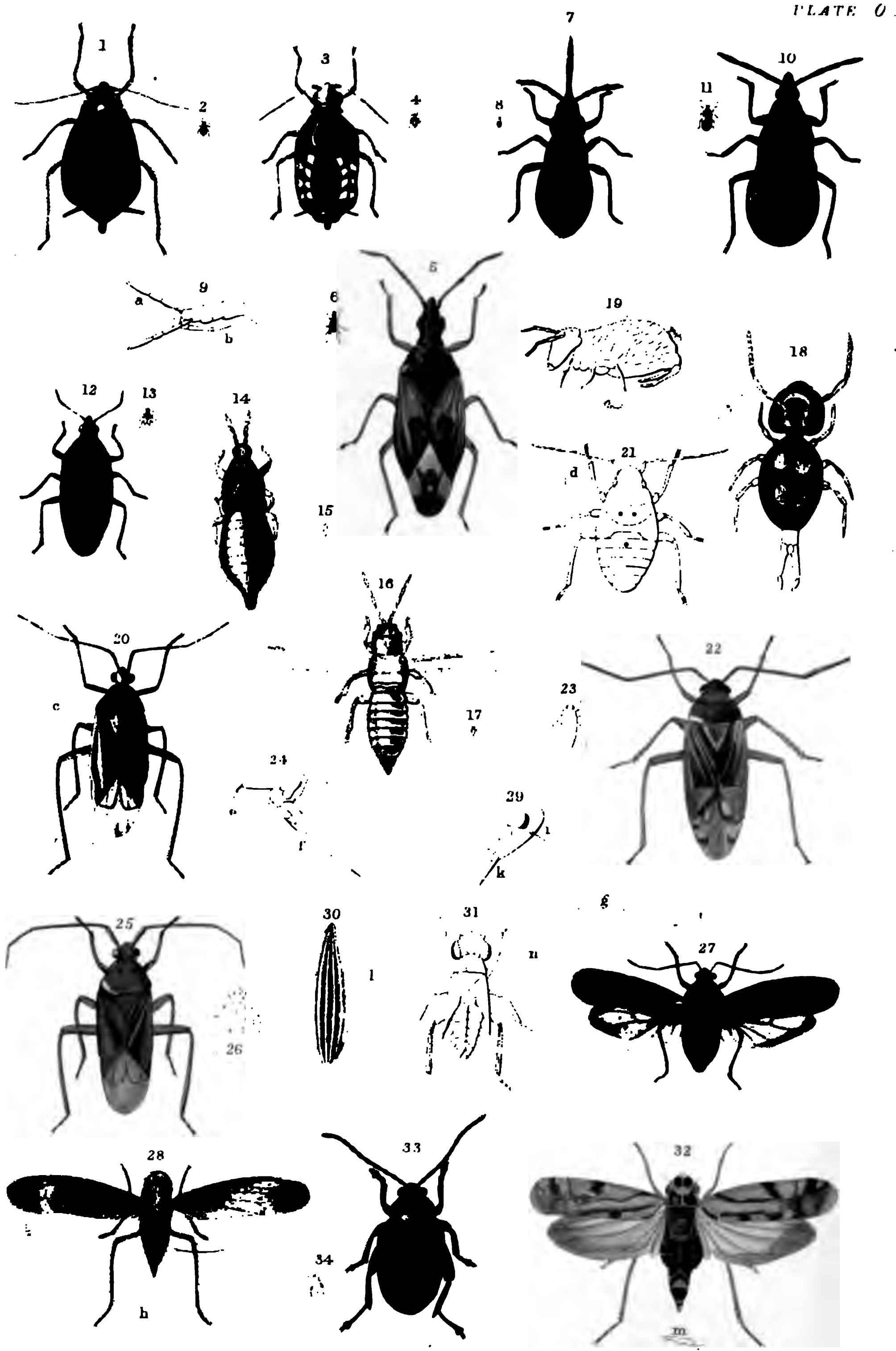
Chelifer inæqualis, a false scorpion, also resorts to *decaying potatoes*, probably to *feed upon the mites*.

A worm, called *Vibrio* or *Rhabditis tuberculorum*, is generated in vast numbers in *putrefying potato heaps*.

POTATO CROP

Plant bugs, Frog-flies, and various insects infesting Potato Crops

PLATE O.



J. H. Le Bron

BLACKIE & SON

Glasgow, Edinburgh & London.

EXPLANATION OF PLATE O.

Fig. 1.* *Aphis Fabæ*, female.
Fig. 2. The natural size.
Fig. 3.* Pupa of *Aphis Fabæ*.
Fig. 4. The natural size.
Fig. 5.* *Hylophila Nemorum*.
Fig. 6. The natural size.
Fig. 7.* The larva state of *Hylophila*.
Fig. 8. The natural size.
Fig. 9.* The head and thorax in profile.
a, The antennæ or horns.
b, The rostrum or beak.
Fig. 10.* Pupa of *Hylophila Nemorum*.
Fig. 11. The natural size.
Fig. 12.* *Hylophila minuta*.
Fig. 13. The natural size.
Fig. 14.* Larva state of *Thrips minutissima*.
Fig. 15. The natural size.
Fig. 16.* *Thrips minutissima* flying.
Fig. 17. The natural size.
Fig. 18.* *Smynthurus Solani*, the potato ground-flea; its natural size is that of a grain of sand.
Fig. 19.* *A Smynthurus* in profile, to show its leaping apparatus.
Fig. 20.* *Lygus Solani;* the potato-bug.
c, The natural length.
Fig. 21.* Pupa of the same.
d, The natural length.
Fig. 22.* *Lygus contaminatus*.
Fig. 23. The natural size.
Fig. 24.* The head in profile.
e, The base of the antennæ.
f, The rostrum.
Fig. 25.* *Lygus bipunctatus*.
Fig. 26. The natural size.
Fig. 27.* *Lygus umbellatarum*.
g, The natural dimensions.
Fig. 28.* *Eupteryx Solani*, the potato frog-fly.
h, The natural dimensions.
Fig. 29.* The head in profile.
i, The antenna.
k, The rostrum.
Fig. 30.* The egg.
l, The natural size.
Fig. 31.* The pupa state.
Fig. 32.* *Eupteryx picta*.
m, The natural dimensions.
Fig. 33.* *Altica* or *Macrocnema exoleta;* the potato flea-beetle.
Fig. 34. The natural size.

Those numbers with a * attached, refer to the objects which are represented larger than hfe, and all the figures are drawn from nature.

CHAPTER XVI.

THE NATURAL HISTORY AND ECONOMY OF VARIOUS INSECTS AFFECTING THE CLOVER CROPS AND PASTURE LANDS.

Having detailed the history and economy of the various insects injurious to turnips, corn crops, mangel-wurzel, pease, beans, carrots, potatoes, &c., as well as those destroying corn in granaries, it now only remains for me to make known to the agriculturist the legions of insects which ravage his clover and other similar crops, his artificial grasses, and pasture-lands.

These crops are the nurseries of those myriads of flies, gnats, beetles, &c., which disperse, and, settling in the fields, carry with them blight and destruction.

Thus the daddy long-legs luxuriates in pastures, and visits the mangel-wurzel; the *Chlorops* and *Oscinis* (little flies) have their head-quarters in the central shoot or flower-stem of grasses, attacking our autumn-sown corn crops in the end of winter; a weevil (*Curculio lineatus*) is propagated in clover-fields, but renders pea and bean fields unproductive by its migrations; and the wireworm finds a permanent asylum in damp pastures.

These are facts well deserving the attention of the farmer; and as some insects cannot exist without humidity, because their transformations are arrested, and the larva dies, or the pupa is unable to produce the fly, so other species only multiply in dry seasons and sandy situations. Moreover, as we know that salt, soda, ammonia, gas-tar, soot, and lime, are destructive to insect life, the farmer could not do a greater service to agriculture than by trying experiments with these substances upon the various pests which may fall under his notice. But unless he records the facts, and sends them, however trifling they may appear to be, to some of our journals connected with agriculture, no beneficial results can be expected. It is only by the united labours and experience of the many that scientific men can draw conclusions on a subject which, like chemistry, has so much concealed from him. A farmer in his field, or a gardener in his garden, may chance to light on a fact in the economy of an insect which the naturalist may have been searching for in vain for years, and it may enable him to comprehend what had hitherto been to him a puzzle or a mystery, and to draw conclusions from it of great practical importance.

CLOVER.

The amount of injury which clover crops suffer from the inroads of insects cannot be estimated. The farmer finds his crop thin, the leaves riddled; and this is the work of a weevil which will pay a visit eventually to his pea and bean fields.* His seeds fail, not yielding a tithe of the full amount. Let him spread a white napkin in the field, and shake and beat the clover-heads, and he will find the destroyer in myriads, probably in the shape of a little black weevil with a long pointed nose. There are also various caterpillars feeding on the foliage which are less destructive, because they are less numerous, from their being kept under, in all probability, by parasitic flies. It will now be my purpose to describe these insects, detail their economy, and suggest remedies against their invasions.

1. CURCULIO (SITONA) LINEATUS, Linn.,

having been described and figured in a previous chapter, I need only refer to it to identify this pest; but as at that time I was not fully aware of its extensive presence in clover-leys, this portion of its history will be useful and instructive.

It is a remarkable fact, that, abundant as this insect is, and a species well known to Linnæus and men of science for more than a century, we are still ignorant of its entire economy. No one knows where the female lays her eggs; no one knows where the maggots feed, or where they change to *pupæ*. I imagine the eggs are deposited in the earth, and that, when hatched, the *larvæ* feed on the roots of the clover; but this remains to be proved, and it would be a most valuable discovery, well worthy the attention of those who find it in abundance on their crops.

These weevils, which sometimes swarm to an extraordinary amount in clover-fields, completely riddle the leaves, reducing them to skeletons. We need not recapitulate the facts which were communicated by Mr. Trenchard and Mr. C. Parsons, and recorded by us in the chapter on pea crops just referred to. It may, however, be stated that nothing regarding their transformations has been since discovered, and consequently no remedies can be suggested for their extirpation beyond those already recommended.

Whilst the *Curculio lineatus* confines itself to the destruction of the foliage of the clover, there is a family of minute beetles or weevils, called

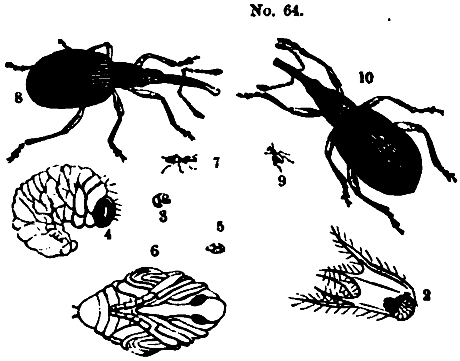
* Chapter xii. p. 346, Plate L, figs. 1, 2.

Apions, which not only devour the leaves, but destroy the seeds also. They are pear-shaped, black or bluish, having a long rostrum or beak, at the extremity of which is placed the mouth. They are very active, running about and falling down on the approach of any one, and they are furnished with ample wings* for flight. The first of these little pests is named—

2. APION APRICANS, Herbst; (A. flavifemoratum, Kirby); *or the Purple-clover Weevil.*

It is shining, bluish-black, pear-shaped, the body being oval and tapering from the thorax, so that the head is elongated into a slender proboscis, which forms, as it might be termed, the stalk of the pear (Plate P, and No. 64, figs. 7; 8 magnified). At the extremity of this beak is placed the minute mouth, which is composed of two horny *mandibles* or jaws (Plate P, fig. 9); they are convex externally, terminating in three teeth, and meeting in front when closed; below these are placed two *maxillæ* (fig. 10), broad and flattened, each forming a ciliated lobe in the inside; just behind this is inserted a very short three-jointed *palpus* or feeler; between these *maxillæ* is placed the horny *mentum* or chin, from which arises a membranous pubescent lip, the *palpi* or feelers being very indistinct (fig. 11). The head and trunk are punctured; the former is channelled between the eyes, and the latter has a channel down the hinder part: the body is covered by two wing-cases, on which are sixteen punctured furrows, and beneath these are folded and concealed the two ample membranous wings. It has two eyes near the base of the head, and the pair of eleven-jointed horns are placed on each side of the trunk, and near the middle; they terminate in a little oval club; the first joint is the largest, and is bright ochreous, and sometimes the second and third also: the six legs are of the same bright ochreous colour, the tips of the thighs being black, as well as the shanks (excepting the first pair), and all the feet; the *tarsi* or feet are composed of four joints, the third being bilobed, the fourth club-shaped and terminated by two minute curved acute claws. The *male* is rather smaller than the *female*, with a shorter and stouter *rostrum*.

No. 64.



* Mr. Markwick was mistaken in supposing *Apion flavifemoratum* had no wings; for they are twice as long as the wing-cases in both sexes.

These little beetles are probably in greatest abundance when the clover is in flower, at which period the female deposits her eggs. This may be easily ascertained by the numbers which are pairing about that time. My observations on their economy have been principally made in the months of August, September, October, and November. On examining the heads of the purple or honeysuckle clover at the end of August and the beginning of the following month, when the clover was in flower and many of the heads appeared blighted, I found three or four little fat white maggots, with brown heads, curled up at the base of the calyces (Pl. P, fig. 1). The larvæ, or maggots, were eating the seed from the outside of the calyx, through a hole which they had first made (Pl. P, and No. 64, figs. 2). They change to pupæ in the same situation, and when the beetles hatch the females proceed, after impregnation, to a fresh head of flowers, to deposit their eggs. In the middle of the following November I again examined the clover-heads, and found two larvæ, curled up like those of the *Melolonthidæ*, with six distinct pectoral legs (figs. 3; 4, magnified). The pupa is of an ovate form, tender, whitish, with dark eyes, and through the thin skin may be traced the form of the proboscis, which is bent down on the breast, below which the legs are folded (figs. 5; 6, magnified). In this state it generally remains about twelve days, or it may be till the following spring. When the beetles are first hatched they are very soft and tender, and I have observed that the wing-cases are then of a gray colour, but they soon assume their proper tint.

I doubt not that these weevils are annually produced in great numbers, for they are common everywhere. I may mention, however, that they were particularly abundant in Surrey and Suffolk in 1840 and 1841, and they were in profusion in the clover fields in Middlesex. Some idea may be formed of the ravages occasioned by this weevil from the following communication made to me in September, 1844, by Mr. William Trenchard of Sherborne:—

"I have a field of clover which has been twice mown, and there is now a fine aftermath. The part of the field near the stack has been lately attacked by a small black weevil, which advances in a semicircle, totally destroying every leaf, leaving only the fibre. I should think there are on some of the leaves as many as 100 or 150. Since last night they have eaten nearly as much as would have kept a sheep. In September they seemed to have been somewhat weakened by the late heavy rains. They destroy every leaf in their progress."

When one sees in a field of clover, which is in flower, patches of discoloured or brownish heads which appear to be withered, it is a certain indication of the presence of these weevils.

This destructive weevil is no new pest, for its economy was known to

Linnæus, and was verified by Mr. Markwick as long back as the year 1800; and in 1801 the latter communicated his observations to the Linnean Society.* In Mr. Markwick's case the larvæ were in full force in the beginning of August, and changed to pupæ in the middle of the same month; and at the same time the weevils were hatching. The damage done at this time is accurately shown by figures, for he states that—

In "1798 I grew on nine acres of ground (just double the quantity that was saved for seed this year) either 33 or 34½ bushels of clover-seed, of which 28½ bushels were sold for 50*s.* per bushel, and the rest, amounting to either 5 or 6 bushels (I am not quite certain which) was kept for my own use; so that, taking it at the lowest, the statement will stand thus:—

		Bushels.		£	s.	d.
In 1798 four acres and a half, being half of the crop, ...	produced	16¾,	which sold for ...	41	17	6
This year (1800) the same quantity of ground produced only, ...	,,	7½,	worth at same price	18	15	0
Deficient, ...		9¼	... worth	£23	2	6

Thus it appears that the loss on this year's crop is very great, occasioned, most probably, by the depredations of this insect; and besides, what seed I have is of an inferior quality."

In 1843 a valuable pamphlet upon the insects injurious to agriculture was published by M. Guérin Méneville,† in which were given some excellent observations upon the economy of this insect by M. Herpin, a translation of which I shall introduce here without further apology:—

"The standing crops of the cultivated clover, *Trifolium pratense* (Linn.), are attacked by a larva of the Family of *Curculionidæ*, which establishes itself in the flowers of that plant, and which, after having pierced the calyx and envelope of the young seed, gnaws and destroys the interior substance as fructification progressively advances. On entering a field of clover while it is in full flower, one perceives, without difficulty, a considerable number of heads, of which the brown and withered corollas and the blackened calyces show that they have long since done flowering.

"On attentively examining some of the full-flowered clover-heads, it will be observed that, among the large quantity of florets composing these heads, many of the florets have already passed the time of flowering; they are brown and withered.

"This premature and partial maturity of the flowers is commonly a

* *Curculio Trifolii, Trans. Linn. Soc.*, vol. vi. p. 142.

† *Extrait des Mémoires de la Soc. Royale et Centrale d'Agric.*, année 1842.

characteristic sign of the presence of the larva of the *Apion* we are speaking of.

"In truth, if we spread open, or carefully pull out, some of these withered flowers, we shall perceive near the base of the calyx, that is, near the point of its junction to the stalk, a small black spot, or little hole, similar to that made by a fine pin; on slightly compressing the calyx, we shall see come forth from this little hole a white, soft larva, rolled up, 1 or 2 millimètres in length.

"When this larva has arrived at its full growth, it forms, outside the hole which it has perforated in the calyx, a globular white projection (at most 1 millimètre in diameter), which might be taken, at first sight, for a grain of powder or plaster.

"This larva afterwards changes to a nymph or chrysalis; it remains in this form for about twelve days. Towards the end of that period, one sees that the nymph, which was originally of an ivory white, is sprinkled with blackish points; the form of the rostrum, the eyes and the legs of the insect are very distinctly indicated under the envelope which covers them; the rostrum occasionally makes slight movements.

"From this *nymph* comes forth the little *Apion apricans*, which has long been known to naturalists, who find it upon walls and in fields.

"My clover was mown in full flower, then dried, although with some trouble on account of the bad weather, and came again into leaf as usual. What could become of the numerous larvæ housed with the clover? They were probably suffocated by the heat, or stifled by the escape of carbonic gas produced by fermentation and the stacking of the plant.

"Ten or twelve days had scarcely elapsed after the housing of the clover in the granary, when I perceived a great quantity of apions moving in all directions upon the walls of the building, and making their way towards the outside. The escape of these apions went on for eight or ten days.

"Although the quantity of these little insects which escaped from the granaries was innumerable (for the walls were covered with them), I could not find a single one at some distance in the country, or even in the nearest plots of clover. However, as these insects, as well as their congeners, shun the daylight and conceal themselves, they might easily escape my investigations through their extreme minuteness and deep green colour.

"But it was a matter of the greatest interest to know whether the second crop of clover which sprung up would be also infested by the apion. I searched with a great deal of attention, and I eventually perceived that the ripest heads were in their turn attacked by the same insect, and that finally the second crop was not less injured than the first had been.

"This second crop was mowed, made, dried, and housed in the granary, as was the custom, and after twelve days the little weevils began to hatch and to issue from the granary; soon after I perceived a very great number descend along the walls and make for the outside, as in the case of the first crop.

"Thus, then, we must conclude, from the facts I have just reported,—1st, That in the space of about five to seven weeks, which is necessary for the growth of the second crop of clover, the pupa of the apion has had time to form itself; 2d, That the perfect insect has been able to copulate, to transport itself into the fields and deposit its eggs upon the plant; 3d, That these have been able to develope themselves, and that the larvæ which have proceeded from them have had the requisite time for reaching their full growth, and finally to destroy and devour the seed produced by the second flowering of the clover.

"I obtained only two crops, but it is probable that the third, if there had been one, would not have fared better than the first two. I ought to observe, that my clover had been chalked (*plâtré*) in the spring, and that it was in its second year—that is, it had been sown the preceding year; and that it had not yet been cut.

"I reckon my loss in the seed-crop in 1841, by the clover-weevil, at one-tenth. The agriculturists also complained, later, that the yield of seed was far from abundant."

There is a species so closely allied to *A. apricans*, that it is believed to be merely a variety. Its habits are the same, and it infests the purple clover; but it seems to be strongly attached to *Trifolium ochroleucum* (the sulphur trefoil). This little weevil is named—

3. Apion Assimile, Kirby.

It is rather smaller than *A. apricans*, and is further distinguished by the base of the horns and the fore-shanks being of a duller colour (No. 64, fig. 9; 10, magnified). This weevil is very abundant from the early spring to late in autumn. In April and succeeding months I have found it in abundance in clover-fields, pastures, meadows, and hedge-rows, and in June on the sulphur trefoil.

The Dutch or white clover (*Trifolium repens*) suffers from the depredations of another allied species of weevil, whose economy has been well ascertained by M. Guérin. This apion is named—

4. A. Flavipes, Fab.—*The Yellow-legged* or *Dutch-clover Weevil.*

It also is similar to the preceding species, but it is still more slender in form, with entirely bright ochreous legs, excepting the tips of the shanks and all the feet, which are intensely black; the two basal joints of the horns are also bright ochreous, and the trunk is not so coarsely punctured as in *A. apricans.* The maggots of this beetle also feed upon the seeds of the Dutch clover. This species is no doubt abundant all the summer, and I have found it in profusion in May on the Dutch clover.

Providentially these weevils are kept in check by various hymenopterous insects. It appears that M. Guérin bred, either from the larvæ or pupæ of *A. apricans*, the minute fly called by Haliday *Calyptus*, the *Eubazus macrocephalus* of Nees. It is full 1 line long, of a black shining colour, with transparent wings, a little iridescent, and the base of the shanks is yellow: the female is armed with an oviduct longer than the body, which it can plunge to the bottom of the calyx of the clover, and by means of which it deposits an egg in the body of the larvæ of the apions. This parasite does not seem to be exempt from persecution, for M. Guérin found with the *Eubazus* a beautifully coloured fly, called by Walker *Petromalus pione*, which is suspected to be parasitic on the *Eubazus.*

It would be productive of incalculable benefit if some means could be adopted for the destruction of the apions, as these crops are of such vast importance to the grazier, both cows and sheep feeding on all the trefoils, and clover being such a substantial and excellent food for horses.

We will conclude this important subject with some sensible remarks from M. Herpin's *Memoir* relative to the destruction of these weevils:—

"Although it be not always in our power to arrest the multiplication of hurtful insects, to destroy them, or to combat them with success, the knowledge of the alterations which they produce upon vegetation is nevertheless very important, since it teaches us to learn the true cause of an evil which may be attributed, but very incorrectly, to vague and inappreciable circumstances, to deleterious conditions of the atmosphere, to divers inexplicable occurrences in vegetation; it shows us the enemy that we must attack, and of which we must carefully study the habits, economy, and metamorphoses, in order to arrive with more certainty at the means of attaining such knowledge. Nature, as I have before said, undertakes the check of the excessive multiplication of hurtful insects—in the case of the clover-weevil, by exposing it to the attacks of the brood of the *Ichneumon braconide*, which destroys it.

"To these natural means which do not always insure us against serious losses, I will add the following, which, it appears to me, might be very usefully employed:—

"1st. Cut early and feed off while green, the clover crops which are known, or supposed to be, much infested by the apion.

"2d. Carefully avoid allowing the clover crops to remain more than two years in succession on the same ground.

"3d. Avoid also allowing the clover which is much infested by the weevil to ripen and run to seed.

"4th. Alternate and vary the culture, as previously pointed out.

"5th, and lastly. We can produce the drying of the clover by the German method, viz. fermentation, by making brown hay (*foin brun*). The alcoholic vapours, the deleterious gases which are formed during the fermentation of clover stacked when green, the high temperature produced in the stack (+60 deg. Cent.,* according to my experiments), suffice to destroy the thousands of larvæ of the apion, which cannot endure so great a heat."†

I must not omit to state that it has been recorded that *Altica nemorum* (the turnip beetle or fly) not only inhabits clover fields, but feeds upon the leaves.

We will now take a view of the moths which resort to clover fields in order to deposit their eggs, so that the caterpillars may be nourished on the leaves when the eggs hatch.

These insects belong to the Order LEPIDOPTERA, and there is also a beautiful butterfly, which is not abundant every year, but is occasionally not very rare about clover fields, over which it flies, and deposits its eggs on a trefoil named *Anthyllis vulneraria*‡ (the Kidney-vetch). As this plant does not form an important crop with the English agriculturist, I shall merely observe that the insect alluded to is named—

5. PAPILIO (*Colias*) HYALE, Linn.—*The Pale-clouded Yellow Butterfly.*

As figures and descriptions of this handsome butterfly are given in the *British Entomology*§ and other works, it is unnecessary to describe it here. It flies in August and September.

There is a large hairy caterpillar which lives on the clover, and produces a fine moth belonging to the Family BOMBYCIDÆ, and to the Genus LASIOCAMPA; it is named—

6. BOMBYX (*Lasiocampa*) TRIFOLII, Linn.—*The Grass or Clover Eggar Moth.*

Head short; eyes small; horns inserted towards the hind part of the head, forming nearly a straight bristle: in the males they are like two beautiful feathers, with a double row of rays; in the females the bristles are merely

* 149° Fahrenheit. † Herpin's *Memoir*, p. 27.

‡ The larva also feeds on *Medicago sativa*, *Trifolium repens*, and *T. subterraneum*.

§ Fol. and Plate 242.

serrated. It has no tongue or proboscis, as moths generally have, but in front of the head are two small, short, hairy lobes, being the *palpi*, or feelers, which, when denuded of the hair, appear to be triarticulate. The males are always smaller than the females; the trunk is large, not crested. The body of the male is attenuated and cleft at the apex; in the female it is stout and somewhat oval, being generally filled with eggs. The wings are rounded and entire, and when closed are deflected, forming a ridge down the back.

This moth varies greatly in colour, from a rusty gray to a brown tint, and the females are always paler; the superior wings are darkest at the base, with a waved flesh-coloured line towards the hinder margin, and near the centre is a white or cream-coloured spot: the under wings are of a uniform colour; legs hairy, stout; the feet composed of five joints, terminated by distinct claws and little cushions: expanse of the wings in the male nearly 2½ inches; the female is larger.*

These moths must be sometimes very abundant. They are found distributed over a great portion of the south and west of England. They make their appearance in July and August, and even as late as September. The males are very active, flying rapidly about during the day, being incessantly in search of the sluggish females, which rest concealed amongst the herbage until they are impregnated by the males, when they relieve their dilated bodies of the large mass of eggs with which they are completely filled; and having thus provided for a future generation, the female parent dies.

The eggs are laid singly; they are somewhat globose, smooth, yellowish-gray, mottled with gray. The caterpillars which hatch from them are little black hairy creatures, which change their colour as they cast their skins, and eventually become large, hairy, handsome caterpillars, full 3 inches long, and as thick as a stout swan's-quill. They have six pectoral, eight abdominal, and two anal feet: they are of a pale smoky or ochre colour; the incisures of the segments spotted with blue. The large eyes appear to cover the head, and the collar is yellowish-red: the spiracles are reddish.

When they are full fed they either spin a loose silken web among the dead leaves or bits of grass and herbage on the surface, or they descend into the earth from one to six inches deep, and there change to pupæ, inclosed in hard, oval cocoons, of a brownish-ochre colour, remaining secure all the winter and spring. The following summer the moth is perfected; it bursts through its shroud, and comes forth to dry and expand its wings—the males making their appearance some days before the other sex, so that they are strong and vigorous before they find their partners. Mr. J. J. Reading,

* Sepp's *Nederl. Insect*, vol. ii. p. 51, Plates 13 and 14.

however, informs me that the eggs hatch in March, that the caterpillars feed till the beginning of July, in which month they change to pupæ, and that the moths are produced the latter end of August. These discrepancies in the periods of appearance may be reconciled by the fact that the insects remain sometimes in the pupa state for two years.

If the caterpillars of *L. trifolii* were confined to clover-fields, their ravages would be a very considerable evil, as they are sometimes found in great quantities on limited spots; but few larvæ subsist on such a large variety of food. It has been ascertained that they will feed and thrive upon various grasses, as well as upon the white and red clover, bird's-foot trefoil, the plantain, bramble, the broom, young furze-shoots, and the heath (*Calluna vulgaris*). It is recorded by Mr. Reading that they will also feed on oak, beech, ash, poplar, willow, whitethorn, and blackthorn.

A closely-allied moth, named by Borkhausen—

7. BOMBYX (*Lasiocampa*) MEDICAGINIS—*The Medick Eggar Moth*,

is in all probability a variety of the foregoing species, the difference of the food affecting the tint and markings of the wings. The *male* is dull chestnut-colour; abdomen brighter; antennæ dull ochreous; eyes ash-coloured; superior wings sparingly speckled with ochreous hairs; an abbreviated and sinuated fascia near the base, and another beyond the middle, slightly toothed on the inside, dull ochreous; a cream coloured spot near the disk approaching the costal margin; inferior wings rather paler, darkest towards the body, with a curved, pale, rather obscure line across the middle.

The characters that distinguish *L. medicaginis* from *L. trifolii* are the abbreviated fascia next the base of the superior, and the obscure one across the inferior wings; the breadth of that which is parallel to the posterior margin of the upper wings is also greater.*

The caterpillars of this variety were found in the New Forest in June; they continued to feed on heath, grass, and medick, until the beginning of July, when they were full grown and changed to pupæ, from whence they emerged the beginning of the following August.

The eggar moths, like most other *Lepidoptera*, are attended by parasites, one being a minute fly belonging to the Order HYMENOPTERA and the Genus TELENOMUS; but I am unable to give the specific name. It is known to puncture the eggs of the oak eggar moth (*L. quercus*), in each of which the female lays an egg; when this hatches the little maggot there finds sufficient nourishment to bring it to maturity.

* See Curtis's *British Entomology*, fol. and Plate 181, where figures of this moth and caterpillar are given.

A large and handsome species of the Family ICHNEUMONIDÆ and the Genus PELTASTES—

8. P. DENTATUS, Fab.—*is specially attached to L. trifolii.* *

It is black, deeply and thickly punctured; the horns are long, stout, straight, tapering to both extremities, and are ochreous beneath; nose yellow; thorax with eight yellow spots before the insertion of the wings, and two at the base of the scutellum, which is margined with yellow behind; abdomen elongated, somewhat depressed, and scarcely narrowed at the base, with four yellow spots on the first and second segments, the remainder margined with yellow. Wings obscure-ferruginous; stigma and nervures brighter. Legs yellow—first pair the palest; the hinder thighs striped, black inside; length, 8 lines; expanse of wings, 11 lines. This ichneumon is seen flying in the sunshine in June, in fir groves; it has been taken on the mountains of Westmoreland, and has been bred from the pupa of *L. trifolii.*

There are two very pretty moths which may be seen flying over clover-fields during the day and sporting in the sunshine, like some of the smaller butterflies called "skippers." It may be supposed that they lay their eggs upon some part of the plant, as the caterpillars which are produced from them feed upon the leaves. These moths belong to the Family NOCTUIDÆ and the Genus EUCLIDIA; one is named

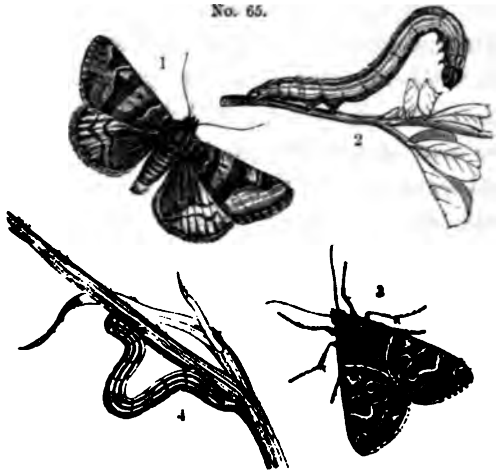
9. E. GLYPHICA, Linn.—*The Burnet Moth.*

Head small, eyes somewhat globose; the horns, which are inserted on the crown of the head, are moderately long, and like bristles, but densely ciliated beneath in the males. In front of the face are two recurved scaly *palpi* or feelers; between these is concealed a spiral tongue, which, when unrolled, is as long as the horns. The thorax and body hairy; the latter is short, obtuse, and tufted at the apex in the male, but stout and cone-shaped in the female. Wings slightly deflected, and forming a triangle in repose: fore shanks very short, with an internal spine, intermediate furnished with several acute spines on the inside, and terminated by a very long and a shorter spur; hinder shanks not much longer, but stouter and hairy outside, with a very long and a short spur at the apex, and a similar pair a little above them; the feet are longer than the shanks, especially the front pair; they are spiny, and composed of five joints, and are terminated by minute claws and cushions. The colour of the head and thorax in this species is orange-brown, the body black, with scattered ochreous hairs; the tail more ochreous; upper wings rosy-

‡ See Curtis's *British Entomology*, fol. and Plate 4, for figures and description.

brown, with a dark brown patch at the base, a broad rich brown fascia across the middle, the ground-colour forming a band down the middle; sometimes there is an oval spot on the disk of the same colour, and towards the tip a triangular brown spot: under wings of an orange colour, the base and fringe black, as well as a border more or less rayed internally, and two waved lines from the anal angle across the disk: under side bright orange, with a black spot on the centre of each wing, and several of the lines and spots on the upper side slightly apparent. Expanse of wings 1 inch to 1 inch and 2 lines (No. 65, fig. 1).

No. 65.



The caterpillars are termed *semi-loopers*, from their peculiar action in walking. They are cylindrical, destitute of hairs, with six pectoral, four abdominal, and two anal feet (fig. 2). They are of a buff colour, and striped, with the head and belly brown. They feed on the purple clover, and also on a *Verbascum* (mullein), and conceal themselves generally between the lower leaves of the clover. They undergo their transformations in that situation in an elongated white cocoon. The chrysalis is brown, powdered with blue; the apex is spined. They remain in this state until the beginning of June, when the moths hatch: they are particularly attached to chalky districts.

The other species alluded to is—

10. Euclidia Mi, Linn.—*the Shipton Moth.*

It is griseous; upper wings with a broad blackish band, margined with ochre, bilobed towards the interior margin, with a round black dot towards the costa, and a large lunate one, edged externally with ochre, beyond it: an ochreous stripe and a row of conical black spots towards the posterior margin; under wings black, with a large bright ochreous spot near the base, and two waved bands divided by black veins, often forming spots: fringe ochreous, spotted with black; margins of abdominal segments pale; under side orange, with black spots and angulated lines: expanse of wings rather more than 1 inch (fig. 3, in repose). The caterpillars feed on clover, lucern, yellow medick (*Medicago falcata*), and grasses, and arrive at maturity in the end of August. They are similar to those of *E. glyphica*, but are of a whitish lilac colour, sometimes inclining to ochre, and striped. They have twelve legs, and form a loop in walking (fig. 4). They must be tolerably abundant, as the moths are very common and widely spread over England, Wales, and Scotland: they are found in May and June.

It appears that clover crops are not exempt from the inroads of the curious little worms called *Vibrio;* for it is stated in the *Gardeners' Chronicle* of the 20th of March, 1852, by Mr. Murcott, of Leamington, that he had discovered in the interior of red clover-seed some worms which he believed to be a *Vibrio.*

Tares.

Tares are infested by multitudes of insects, the larvæ of beetles, moths, and flies; amongst the latter is one which reduces the seed crop to a great extent. In July the flower-heads are often distinctly distorted; and on opening them numbers of maggots are found concealed in and amongst the calyces or cups of the flowers, where they eat into the base and entirely consume the incipient pod. These little larvæ are 1 line long, of an orange colour, tapering to the head, and blunt at the tail. In all probability they are the offspring of some species of *Cecidomyia* allied to the wheat-midge.

Vetches are also seriously injured by the maggots of a little weevil—

11. Apion Pomonæ, *Fab.;* A cœrulescens, *Kirby.*

This weevil is larger than the clover Apions which have just been described; the *female* is of a black colour, entirely clothed with very short hoary hairs; head punctured; rough between the eyes; proboscis short, thick, hairy, punctured, apex attenuated and curved downward, dilated at the middle beneath (Plate P, fig. 12); horns moderately long (fig. 13), inserted in cavities at each side of the proboscis towards the base; eyes prominent; the trunk black with a bluish tint, broadest behind, with a channel before the scutel, punctured, and with hairs; wing-cases covering the body, oval, narrowest at the base, bluish, with longitudinal punctured furrows, the spaces between them flat. A pair of ample, nearly transparent wings, are folded beneath the wing-cases in repose. The six legs are moderately long, the feet four-jointed, the third bilobed, the fourth with two small claws (fig. 14). The *male* is similar to the female, but the proboscis is smooth, shining, and more attenuated; forehead between the eyes with two impressions (fig. 15); the horns with the first joint reddish at the base. It varies in length from $1\frac{3}{4}$ to $2\frac{1}{3}$ lines (fig. 16; 17, the same flying, and magnified).

They fly well, even when the sun does not shine, especially the males. As early as May these weevils are found on the whitethorn, and are abundant until the autumn on heaths, fir-trees, and oaks; they also inhabit hedges, and must frequently abound in cultivated fields, as I have ascertained that the female deposits her eggs in the pods of the bush-vetch (*Vicia scpium*), and the following are my observations on the economy of this weevil. The end of July, 1847, I found in a field of tares or vetches (*Vicia sativa*), left for seed and partly ripe, a great number of the pods, which were more or less distorted (fig. 18). On opening them I found the seeds partially eaten, some with only a hole in them (fig. 19), surrounded by abundance of brown and white excrement; other seeds were hollowed out, and a cell formed in each of them, of an oval form, but irregular; in these cells was either a fat maggot (fig. 20?* 21, the same magnified) or a pale ochreous pupa, which I at once saw was that of some weevil. On the 16th of August three specimens of *Apion pomonæ* hatched—one male and two females. When first disclosed they were of a dirty ochreous tint; the head and disk of the thorax soon became blackish, as well as the legs, the thighs having a large and the shanks a small ochreous spot on each; and eventually the beetle became black and hard.

Experience shows that the bush-vetch (*Vicia sepium*) is difficult to cultivate on a large scale, the seeds being generally devoured by the larvæ of a species of *Apion* (probably *A. punctiger*, the *A. punctifrons* of Kirby), said to resort to this vetch only, which larvæ are again the prey of a species of minute ichneumon. *Apion subsulcatum* also inhabits the same plant.

Vicia sepium likewise affords nourishment to a minute caterpillar, which mines and feeds on the pulp of the leaves. It is the offspring of a beautiful little moth included in the Family TINEIDÆ, and forms one of the members of a rather numerous group or Genus which is recognized by modern authors as LITHO COLLETIS, and has been described by Zeller as—

12. L. BREMIELLA.

"The head is fuscous, face and palpi silvery; antennæ fuscous, the tip whitish in certain lights; anterior wings rather dark saffron, with a short, straight basal streak about a third of the length of the wing, dark, margined on both sides; in the middle is an angulated silvery white fascia, margined with black internally, and with a few black scales on its outer margin; beyond are three small silvery white streaks on the costa (the third sometimes wanting); they are internally margined with black. Intermediate between these are two larger triangular silvery white spots on the inner

* Although I bred this weevil, I cannot be certain that these larvæ are not the maggots of some parasite.

margin, dark-margined on both sides; on the apex of the wing lies a rather small oval black spot; hinder marginal line dark fuscous; cilia beyond pale gray. Posterior wings gray, with paler cilia."

Expanse of the wings, 3½ to 4¼ lines.* The larva mines the leaves of various species of *Vicia*. Mr. Stainton found them, in the end of September, by the side of a wood. The leaves at that time contained full-grown larvæ and pupæ in some abundance. The moth appeared a few days after. There are evidently two broods in a year: the caterpillars of one feeding in July, those of the other in September. Some of the latter become moths in October, whilst others remain in the chrysalis state until the following spring. I am indebted to Mr. J. W. Douglas for the following additional observations relative to the singular economy of this little insect:—

"I have inclosed a few leaves of *Vicia sepium*, in which the pupæ were, to show the bladder-like effect produced by the feeding of the larvæ. The two skins are quite separated. We do not find these larvæ on every plant, but, where they do occur, every leaflet on a stem is frequently tenanted. It has been remarked, in Germany, that this species is found on the *Vicia* only when it grows at the margin of woods, and our experience in this country hitherto agrees with this."

Mr. Douglas has also kindly communicated to me notices of the following species of some allied minute moths whose economy is connected with the trefoils; but as they are not known to affect the crops, we need only refer to them here.

13. GELECHIA ANTHYLLIDELLA, Hübner's *Tineæ*, fig. 330.

The caterpillars feed in April and June on the united leaves of the red and white clovers, *Anthyllis vulneraria* and *Onobrychis sativa*: the moths hatch in May and August. Another species is—

14. COLEOPHORA DISCORDELLA, Zeller. *Linnæa Entom.*, vol. iv. p. 301.

In spring and autumn the caterpillars are found in little cases attached to the leaves of *Lotus corniculatus*, and the moths from them make their appearance in June and July. A third species of these little moths is—

15. COLEOPHORA DEAURATELLA, *Lienig. Isis von Oken* for 1846, p. 295.

The moths being always found in clover fields, it is presumed that the caterpillars feed upon the leaves, but at present they are unknown.

On the 12th of February, 1841, Professor Henslow sent me some tares;

* Stainton, *Entomologists' Annual*, 1856.

at the base of the calyx were two, three, or four little maggots, which had eaten out the germen, but sometimes without touching the base of the pod or the corolla (fig. 22). They were of a pale yellowish white with orange, forming an interrupted line down each side of the back, and spreading towards the apex, which was slit; they were granulated or punctured, with a pair of short rigid bristles on each side of the head (fig. 23; 24, the same magnified). They were probably the larvæ of some *Apion*, but they all died, owing to the tares being kept too dry.

On the 12th of July, 1848, I examined about an acre of vetches in a field, three-quarters of which had the flower-heads distorted, and could produce very little or no seed. The leaflets in many instances were blotched with brown, and on opening the heads I found numbers of maggots concealed in and between the calyces; they ate into the base, and were visible only on forcing open the calyces; some of the heads were advancing to flower, and in the withered flowers were one or two of these maggots, which had entirely consumed the incipient pod. Whether these were the maggots or not of *Apion pomonæ* I am unable to say. At the same time there were also many ochreous apterous larvæ of some *Thrips*, and likewise little lead-coloured transparent ones running amongst the heads of flowers, which were the larvæ of a *Nitidula*, or some other little beetle. These were accompanied by a minute species of *Acarus*, or mite, which fed upon the *Thrips*.

SAINFOIN.

It is the practice in chalky districts to sow sainfoin, which is kept down for some years; and when the land is again broken up it is sure to yield a plentiful crop of wireworms. It is customary to burn the surface after paring it; but this does not always preserve the succeeding crop of turnips, &c., from the ravages of the wireworm. Mr. W. Leyland Woods, of Chilgrove, near Chichester, informs me, that part of a field so treated produced a good piece of Swedish turnips, whilst the rest of the field failed. He observed that when the land was pared in March there was no injury to the crop, but the longer the work was delayed in the spring the less was the hope of retaining the plant. Mr. Woods suggested watering the land with gas-tar water, but whether this proved an effectual remedy I have not learned.

Sainfoin is, like most of the other trefoils, the favourite resort of the little weevils to which we have so often alluded in this chapter. One is named by Mr. Walton—

16. Apion Hedysari

The *male* has been named by Schönherr *A. livescerum*, and the female *A. translatitium*.

It inhabits the sainfoin (*Hedysarum onobrychis*), and is found in chalky districts in Kent, in abundance, from May to October. Mr. Walton describes this apion as of a "plumbeous black colour, glossy, sparingly clothed with fine cinereous hairs; head subquadrate; the vertex, adjoining the thorax, smooth; the frons posteriorly slightly convex, closely punctured between the eyes, commonly flat, sometimes depressed, longitudinally rugose-punctate, with one or two impunctate striæ, more or less distinct; eyes prominent; rostrum moderately stout, nearly as long as the head and thorax together, curved, a little attenuated in front, rather thickly punctulated throughout, black and slightly glossy; antennæ medial, rather longer than the rostrum, totally black: thorax very little longer than broad, sub-cylindrical, broader behind than before, the anterior margin elevated, laterally scarcely dilated, convex above, coarsely and thickly punctured posteriorly with a deep dorsal channel more or less abbreviated in front, plumbeous, black, and shining: scutellum triangular, black; elytra long-obovate; the shoulders nearly rectangular; the humeral callus elevated; convex above, deeply punctate-sulcate, the interstices flat, transversely rugulose, sometimes coriaceous, greenish blue, rarely blue or blue-black; legs moderately long, black. *Male*, $1\frac{1}{4}$ to $1\frac{3}{8}$ line long.

"The *female* differs in having the head narrower; the rostrum longer, slender, filiform, and shining; the antennæ inserted behind the middle of the rostrum."*

Nothing is at present known of the transformations of this weevil; but as it is so abundant in the flower-heads of the sainfoin, and the above accurate description will enable the naturalist to identify the species, I hope that ere long its economy will be ascertained.

We may notice that *Lotus corniculatus* (the common bird's-foot clover) supports *Apion loti*, which is abundant on that plant in June; and the flowers of the same plant are sometimes strangely metamorphosed in appearance by a little midge called *Cecidomyia Loti*.

Apion Ervi and A. Lathyri are found on *Lathyrus pratensis* (everlasting tare).

Apion Viciæ is plentifully found upon the wood-vetch (*Vicia sylvatica*).

* See *Ann. and Mag. Nat. Hist.*, vol. xiii. p. 49.

Lathyrus Nissolia (crimson grass-vetch) is particularly subject to the depredations of an apion.

Another beetle has recently been observed to injure the tares; and were it to appear annually in such great abundance as it did on one occasion, its ravages would prove a great loss to the cultivator. In July, 1850, Mr. F. Bond exhibited before the Entomological Society of London the larvæ and beetles of a species, named *Chrysomela polygoni*, which had destroyed many acres of tares in Cambridgeshire. It also inhabits the dock, sorrel (*Rumex acetosa*), and knot-grass (*Polygonum aviculare*), from whence the beetle receives its name of *polygoni*. On these plants it is generally abundant from the early spring to midsummer.

17. Chrysomela (*Phædon*) Polygoni, Linn.

It is oblong-ovate and very convex (fig. 25; 26, the same magnified); the mouth comprises an upper lip (fig. 27), two mandibles or jaws for biting (fig. 28), two maxillæ with two palpi or feelers (fig. 29), and an under lip with two small feelers (fig. 30); the horns are moderately long, black, eleven-jointed, slender at the base, and thickened at the apex into a club (fig. 31): it is finely punctured; head small, greenish, or deep blue; thorax convex, broader than long; the lateral margins not thickened, shining, entirely reddish; wing-cases rather more deeply punctured than the thorax, violet-blue or green; beneath them is concealed an ample pair of wings: breast, middle of the under side of the thorax and the abdomen blue; tip of the latter and the shortish legs reddish. The feet are slender and four-jointed (fig. 32): length, 1¾ to 2½ lines.

The lucern in France (*Medicago sativa*) suffers severely from a beetle which does not inhabit England. I shall therefore only briefly notice its economy. It is the—

18. Colaspis atra

of authors, which eats off the leaves in the perfect as well as in the larva state, leaving only the foot-stalks; so that, instead of getting four crops, as the farmer ought to do, he rarely gets two. Thus this insect is a worse enemy to the lucern than the *Apion apricans* is to the clover.*

Clover and artificial grasses are said to suffer from the inroads of the ladybirds, which is a very curious fact, the favourite food of the British species being the *Aphides*, as we have shown in an early chapter.†

* See *Ann. Ent. Soc. de France*, 1844, p. 271.

† Chapter iii. p. 63.

19. COCCINELLA IMPUNCTATA

is reported by Dr. Hammerschmidt and Mr. Heeger to do mischief in its larva state to various sorts of clover, the tare, sainfoin, and lucern (*Medicago sativa*, Linn.), by consuming the cellular tissue of the leaves. The larva is yellowish white, with small green spots, the upper side clothed with prickles. It changes to a pupa of similar colour, and slightly hairy. The beetle is nearly semi-globose, yellowish red above, pitchy beneath, a spot on the thorax, and the legs are reddish brown.

It is in dry seasons and poor soils that the clover suffers most from these insects, as the produce is then so small that they are not disturbed by repeated mowing; whereas in moist seasons a more rapid growth is acquired, and, the crop being often cut and carried from the field, the insects cannot pass through their metamorphoses. This ladybird is common everywhere in Germany annually; but I do not remember its occurrence in England: at all events it does no mischief here.

PLANT-LICE.

The clover crops do not seem to suffer from the attacks of *Aphides;* but vetches, like pease and beans, are frequently infested by them.

20. APHIS VICIÆ, *Fab.;* A. Pisi, *Curt.*

I have found this species in abundance, in May and June, on vetches. At that time the apterous females, as I presume them to have been, were very large and of a bright green colour. In the middle of June I observed families of all sizes of the same species infesting the heads of gray pease: these were also all apterous; but in the beginning of July the winged specimens made their appearance, and were no less plentiful on the broom.

Mr. F. Walker, who is so well conversant with the economy of the *Aphides*, has favoured me with the following observations on the species just alluded to. The variety of names it bears, and the multitude of plants which this plant-louse inhabits, will give some faint idea of the time and labour required in the investigation of such subjects.

Mr. Walker says—

"I believe that the synonyms of *Aphis pisi* (the green dolphin) stand thus:—*Aphis Ulmariæ*, Schrank, '*Fauna Boica;*' *Aphis onobrychis*, Fonscolombe, '*Ann. Soc. Ent. France,*' x. 169-9; *Aphis pisi*, Kaltenbach, '*Mon. Pflan.,*' i. 23-11, Curt.; *Aphis lathyri*, Sir Oswald Mosley, '*Gard. Chron.,*' i. 684. It feeds on *Spiræa Ulmaria*, *Genista Anglica*, *Spartium scoparium* and *Cytisus*, *Colutea arborescens*, *Lathyrus odoratus* and *pratensis*, *Pisum* *sativum* and *arvense, Phaseolus vulgaris* and *multiflorus, Vicia sepium* and *sativa*, and *Faba, Ervum, Hedysarum, Onobrychis, Lotus corniculatus* and *uliginosus, Trifolium pratense* and *repens* and *filiforme, Ononis repens* and *hircina, Geum urbanum, Epilobium montanum, Capsella bursa-pastoris, Chærophyllum temulentum* and *sylvestre, Artemisia absinthium*, and *Tanacetum vulgare*."

The viviparous wingless female.—Large, yellowish green, or green, sometimes rose colour or purple; antennæ brown or black, nearly as long as the body. Abdomen attenuated at the tip; tubes about one quarter the length of the body; legs long; knees, tarsi, and tips of tibiæ black or brown.

The viviparous winged female.—Like the wingless female. Thorax buff colour; wings vitreous; tips of the veins very slightly clouded.

The winged male.—Black or brown; antennæ longer than the body; femora and tibiæ more or less yellow towards the base.

SNAKE MILLIPEDES.

On the 21st May, 1845, I received an interesting communication from Mr. Frederick Kelly, of Northfleet, Kent, relative to his crop of lucern, which was suffering much from the presence of large numbers of a snake millipede, which, on examination, I found was a species named *Julus Londinensis*.* The plants forwarded to me had the stems deprived of the bark close to and under the surface of the soil, and no doubt had been thus injured by the *Julus*. The leaves were dead on the branches. As the snake millipedes have been described and figured in this volume,† and their habits and economy thoroughly investigated, I shall only add Mr. Kelly's own account of the damage done to his crops of lucern by *J. Londinensis*. It was at the above date "in great numbers round my lucern-plants. All I send were taken this morning from two plants; these worms [millipedes] get amongst the lower shoots on the surface of the ground, some few burying themselves a little below." Mr. Kelly concluded, from the yellow and faded appearance of the plants, that these animals were the cause, for at the roots of the green and healthy plants he could find none of the millipedes. There were also a few wireworms on the ground, which might, he thought, assist in the mischief. In order to destroy the wireworms, Mr. Kelly gave his land the year before a dressing of soda-ash. He further stated that this portion of the land, which was in beans when he wrote, was healthy and free from millipedes. Mr. Kelly then adds:—

* Chapter vii. page 202. † Ibid.

"Thinking to destroy these dark-brown worms, I dressed a row of lucern, a week since, with soda-ash, putting a small quantity near each root; another row with a solution in water of soda-ash; and I tried a row with flower of sulphur. The dry soda-ash appears to have driven the greater part of the worms from the surface to a few inches below it; the solution appears to have nearly sent them away from the plants to which it was applied, but the plants themselves appear injured by the application, and I therefore fear to go on with it; the sulphur has produced no effects on either plants or worms, except that the latter have taken themselves out of immediate contact with it."

As the best modes of destroying the snake millipedes have been fully discussed in the chapter already alluded to, we need not further comment on that part of their history.

Snails and Slugs.

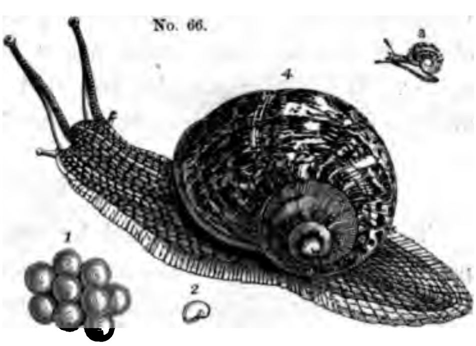
As these animals frequently swarm in our fields and gardens, and unquestionably consume a large amount of the clover crops, we cannot introduce their history on a better occasion than the present. There are several species of snails which are denizens of our fields and hedges.

Snails and slugs being hermaphrodites, every individual is capable of producing eggs.

21. Helix hortensis (called also H. aspersa)—*the Garden-snail.*

The eggs of this species are laid in heaps in the earth, amounting to a considerable number; I have found at least eighty in one cluster. They are globular, whitish, shining, and not bigger than large shot (No. 66, fig. 1). In damp situations they soon hatch, when they become at once little, thin, transparent, and nearly colourless shells (fig. 2). They shortly increase to double the size, even when they have had nothing to feed upon; they then assume a dark ochreous colour, with three imperfect rings, composed of brownish dots and streaks, and a transverse line of the same colour next the

No. 66.



pale lip or margin, and these spots seem to vary as the animal withdraws or extends itself, owing to the dark tints shining through the semi-transparent shell (fig. 3). As the snail grows, it has the faculty of enlarging the shell from its own secretions, and when full grown it is as large as a moderately sized plum (fig. 4); it is convoluted, obliquely striated, of an ochreous colour, and variegated with pitchy spots, giving it a marbled appearance, and forming two or three transverse bands: the lip is ochreous, the margin reflexed; the under side is smooth and white, with a pinkish tint. The inhabitant of the shell at this period is 2 or 3 inches long, when at full stretch: it is scored or wrinkled, like the lengthened meshes of a net, whitish, with the back and head of a pale inky or slate colour; the four horns are retractile, the superior pair being the longest, slightly tapering, with a globular knob at the extremity containing a black dot, which is probably the eye, and, if one of these sensitive horns be touched, it is instantly withdrawn and shortened: the two inferior horns are much smaller, and below these is placed the mouth (fig. 5).

Drought and cold are inimical to snails; they therefore are only in full activity in damp situations, and after showers in mild weather, when they come out to feed, giving the preference to the night. On the approach of winter they hide themselves and adhere closely to stones, palings, &c., and even to one another, by means of a slimy secretion with which they close the orifice of the shell: thus hermetically sealed, the air is entirely excluded. They there remain secure and dormant, and can thus retain their vitality for incredibly long periods, even for fourteen or fifteen years.

Two smaller snails named *H. virgata* and *H. rufescens*, are in the utmost profusion on the borders of fields of every description, as well as pasture lands in chalky districts. In Kent they may absolutely be collected by bushels.

A large and handsome species, *H. nemoralis*, is exceedingly abundant in hedges, upland pastures, and clover-fields. Snails are a favourite food of the thrush and blackbird, as is evident by the number of broken shells one sees along hedgerows and banks where those birds resort, especially in the spring. It is also a singular fact that glowworms (*Lampyris noctiluca*),* and the female of an allied genus named *Drilus flavescens*, feed upon snails.

Slugs.

The depredations committed by snails on the crops are insignificant compared with the ravages of slugs. There are few seasons of the year when slugs are inactive, for even in mild winters they are concealed in the earth and come out to feed; but it is in spring and autumn that they do the most mischief. This is so well known by every farmer and gardener, that we need only allude to that part of their history.

* Curtis's *British Entomology*, fol. and Plate 698.

Slugs lay their eggs in humid spots, and they hatch in three or four weeks. I may mention that in pulling up some grass at the end of September I found numbers of eggs at the roots, with multitudes of slugs and many snails. The slugs were of the milky sort, and I doubt not that some of the eggs, which were of the size of turnip-seeds, were laid by them. With them was also a pair of the large, ochreous rough slug, laying eggs, and on crushing them a string of full-sized eggs were protruded from each slug. The eggs were contained in a tubular vessel, and appeared then opaque-white, owing to the membrane covering them. These large eggs varied in form: they were principally oval, but a few were nearly globular, and some of them were conical at one end. They were ochreous yellow, and like bags of jelly. A few weeks previously I had found at the roots of another plant a large mass of these eggs.

The scientific name of slugs is—

LIMAX.

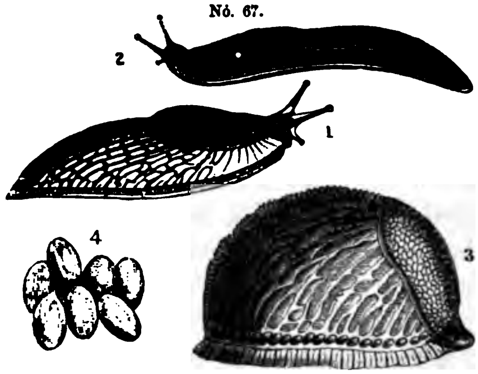
They have four tentacula or feelers, which are very sensitive, and are concealed in repose. At the tips of the longer pair are placed the eyes. They have a fleshy shield covering a horny plate, and are, like snails, hermaphrodite, the aperture on the right side opening into the organs of generation and of respiration.

The species vary greatly in colour, and measure from ½ inch to 5 inches in length. The first of the three commonest species is—

22. LIMAX AGRESTIS—*the Milky Slug.*

It is whitish or ash-coloured, with black tentacula, either immaculate or with scattered black specks and a yellowish shield (No. 67, fig. 1).

No. 67.



23. L. ATER—*the Black Slug*—is furnished with deep wrinkles, and has a rough shield: it is sometimes deep black, pale or white beneath, with a yellowish mouth and a pale greenish ridge down the back. Sometimes it is of a dusky or chestnut colour, with a yellowish streak on each side (fig. 2). *L. empiricorum* is merely an adult variety of the former species (fig. 3, in repose; fig. 4, the eggs).

24. L. MAXIMUS—*the Black-striped Slug*—

grows to the length of 5 inches: it is ash-coloured, sometimes spotted, or with a black shield and the body striped with black; or with fine whitish streaks, the lower one interrupted; or with the body edged with white.

Limax ater is recorded to have eaten sea-sand, paper, and meat.* *L. rufus* and *agrestis* are very partial to firm and crisp fungi and damp *boleti;* but of all the vegetables which slugs feed upon there are few, probably, more acceptable to them than clover and vetches.

Abundance of remedies for destroying slugs will be found in the *Gardeners' Chronicle* and various works on horticulture; and it is not so difficult to decoy and destroy them in gardens; but in turnip and pea fields, young corn crops, clover-layers, &c., their destruction is almost impracticable. I expect that ducks turned into our fields are by far the most effectual remedy; but no doubt, if cabbage leaves or slices of turnips be scattered along the furrows, enormous quantities might thus be collected and given to the pigs. Wood-ashes, or charcoal-dust, are perhaps more efficacious than soot or lime. Salt sprinkled over the land is certain destruction to the slugs when they come forth at night, or after a shower, to feed: it should be scattered at the rate of four or five bushels per acre before the crop is sown. Lime-water is well known to kill slugs. The watering should be repeated as soon as possible, for slugs have the power of throwing off their slimy coating and crawling away; but a second sprinkling soon causes their death, as they are unable so speedily to secrete a fresh covering of slime. Nitrate of soda dissolved in water is another excellent remedy.

In alluding to these remedies I would observe that, as far as clover crops are concerned, their application seems to be impracticable; and I think it doubtful whether the presence of slugs in clover fields be of any real consequence, except as regards the crop which is to follow.

GRASS AND PASTURE LANDS.

Although there is no portion of the globe which may not sustain insect life whether hot or cold, wet or dry, high or low, barren or cultivated, yet, no doubt, woods, forests, and grass-land have been from the earliest ages the homes and habitations of the insect race. Grass especially is the natural covering of the soil, which has been increasing in depth and bulk from the creation, not only from the natural and annual decay of vegetable matter, but from the manure produced by herbaceous animals and the labours of the insect race. These again attract certain birds which feed upon them,

* *Ann. Nat. Hist.* for 1839, vol. ii. p. 310.

as well as upon seeds, and supply, no doubt, an enormous amount of guano. Insects have therefore revelled unmolested in their native haunts from the creation, through the pastoral ages to the present period, and such localities will ever be the head-quarters of this pigmy but formidable race, which, were it not for the natural checks provided by Providence, would overrun the earth and eventually annihilate all vegetation. It is accordingly to be expected that grass-lands would swarm with insect life, both above and below the surface; and being thus the nurseries for the deposition of the eggs and the nourishment of the larvæ, it is naturally to be expected that a crop immediately succeeding fresh broken up pasture land would fall a sacrifice to the inroads of insects, unless special care be taken to eradicate the enemy by paring and burning before the corn or other crops be sown.

It also becomes more difficult to obtain good yielding crops in a mixed tenure of corn and grass land, or in the neighbourhood of marshes, pastures, and grass lands, as the insects bred there migrate to the adjoining arable lands, and often find food more agreeable to them than that which they have deserted, so that the click-beetles, moths, and crane-flies depositing their eggs, the farmer soon finds his land infested by wireworms, surface-grubs, and leather-jackets, to which his turnips, beet, and corn fall a sacrifice.

To make the farmer acquainted with the hosts of insects which find a home in pasture land would occupy volumes; it will, however, answer every purpose connected with the object of this volume, if we lay before him the most important species which feed on the seeds, flowers, and foliage, those which live upon or in the stems, and others which consume the roots.

The tribe of insects which we shall first notice is the family of *Aphides*, or plant-lice. It is a confirmation of my views on this subject to find that the plant-lice which infest the wheat are generated on the panicles of grasses, as I learn from Mr. F. Walker, who has kindly communicated the following observations, and descriptions of two species.

25. APHIS AVENÆ, *Fabr.* A. granaria, *Kirby.* A. Hordei, *Kyber.* A. cerealis, *Kaltenbach.*

Feeds on *Secale cereale, Triticum æstivum, Avena sativa, Danthonia strigosa, Hordeum vulgare, H. murinum, Bromus mollis, B. secalinus, Dactylis glomerata, Holcus lanatus, Glyceria fluitans, Poa annua,* and other grasses, and *Polygonum persicaria.*

Wingless female. — Colour red, green, brown, or yellow: front convex in the middle, and with a distinct lobe on each side: antennæ black, nearly as long or longer than the body: abdominal tubes black, nearly one-fourth of the length of the body: knees, tarsi, and tips of the tibiæ black.

Winged female.—Brown, rarely green: abdomen with a row of black dots on each side: tip yellow: stigma brown; wings vitreous: veins pale yellow.

26. Aphis Dirhoda, *Walker* (*Annals Nat. Hist.*)

Feeds on *Rosa centifolia*, *R. canina*, and *R. eglantina*, and migrates in the summer to different species of corn and grasses, *Secale*, *Triticum*, *Avena*, *Hordeum*, *Bromus*, *Dactylis*, *Holcus*, and *Poa*. It feeds on the leaves of these plants, whereas *Aphis Avenæ* prefers the flowers.

Wingless female.—Oval, pale greenish yellow; front prominent between the eyes: antennæ with brown tips, about one-fourth of the length of the body: abdomen brown at the tips; tubes with brown tips, about one-sixth of the length of the body: tarsi pale brown.

Winged female.—Pale green, or yellowish green: antennæ brown or black, much shorter than the body, as long as the body, or longer than the body: thorax buff: lobes pale brown: abdominal tubes sometimes with black tips, one-sixth or nearly one-fourth of the length of the body: tarsi and tips of the femora and of the tibiæ brown or black: wings vitreous: stigma and veins brown: costa pale green, or pale yellow.

Oviparous wingless female.—Straw colour, buff, orange, or rose colour.

Winged male.—Buff or pale orange: head and disk of the thorax brown or black: antennæ black, much longer than the body: abdomen with a black line along the back, and a row of black dots on each side.

In 1841 Mr. J. G. Lowder made some remarks upon the failure of the seed of *Festuca loliacea*, which he attributed to the presence of plant-lice. In a letter addressed to the Royal Agricultural Society he says:—

"This failure, I am much inclined to think, will be found to be occasioned by the ravages of an insect of the *Aphis* tribe; for on ten out of the eleven seed-stalks which I first collected I observed the heads of many such insects closely imbedded between the valves of the flowers, obviously in the act of feeding, and most probably extracting the saccharine matter. The germ thus injured must necessarily be barren and unproductive."

Having had no opportunity of examining the species alluded to by Mr. Lowder, I am unable to give their name, but I conclude they are some of the *Aphides* described by Mr. Walker.

It is recorded that the slender fox-tail grass, spear-grass, or black-bent (*Alopecurus agrestis*), which is so troublesome a weed amongst wheat, has a large portion of the seeds annually destroyed by a minute orange-coloured maggot, no doubt the offspring of a *Cecidomyia*, and probably the "wheat-midge." Indeed, one can scarcely examine a flower-spike of any grass without finding an abundance of these minute orange maggots; but as the species of midge has not been yet ascertained, I shall simply refer to their history and economy in a former chapter,* where the wheat-midge, *Cecidomyia Tritici*, is described and figured.

Meadow fox-tail grass (*Alopecurus pratensis*) is subject to the depredations of the larvæ of a species of *Musca*, which devours the seed so much that in many spikes scarcely one will be found perfect. I wish I could give the name of this fly, but at present its transformations seem to be unknown. Mr. H. Gibbs informed the same society that all the species of *Agrostis* likewise were subject to the depredations of a little orange-coloured larva to such an extent that in most cases not more than one seed in a dozen ever vegetated on sowing. These larvæ are the prey of *Cimex campestris* (a little plant-bug), whose rostrum seems peculiarly formed for searching the husks of the grasses.†

The GENERA *Chlorops* and *Oscinis* are next deserving our notice. There can be no doubt that these flies are generated to a wonderful amount in the stems of grasses, yet the economy of the various species so generated has, I believe, as yet escaped the notice both of agriculturists and naturalists. In all probability the grasses most affected by these flies are species of *Avena* and *Lolium*, which bear the greatest affinity to the oat and wheat; but this is merely my own conjecture.

As the history and economy of certain species of these flies were fully investigated and discussed in a former chapter,‡ we need only refer to it for further information: the figures and descriptions there given will satisfy the inquirer who wishes to become acquainted with the various species.

EARWIGS.

Earwigs are so abundant everywhere, and occasionally swarm in such countless myriads, that they not only become troublesome even in our houses, but are one of the greatest pests wherever flowers, fruit, or vegetables are to be found. The grasses, when in flower, are a favourite haunt of these insects, and although the farmer does not suffer such severe losses from their inroads as the florist and horticulturist, yet, no doubt, they often assist in the destruction of young crops, eating the plants off as soon as they shoot from the earth. Earwigs may not only injure the crops in their early stages of growth, but amongst wheat, grasses, &c., the fructification may be affected by their feeding on the pollen. They compensate, however, in some measure for the mischief which they produce by the destruction of the *Aphides* and the *Thrips*. They are most voracious insects, coming out at night from their haunts to

* Chapter ix. p. 260, Plate I. † Kirby and Spence, 6th ed. vol. i. p 146; and 7th ed. p. 99.
‡ Chapter viii. p. 234; Plate H, figs. 4—6. Ibid. p. 239; Plate H, figs. 11, 14.

feed, and at that time they will attack even bees, especially several wild ones, called *Osmia bicornis*, *Colletes*, and *Anthophora*, which are sometimes almost exterminated by them. They devour the pollen, pupa, or the imago indifferently;* and when confined and hard pressed by hunger, they will attack and destroy each other. They live all the year round, retiring in winter into crevices in the soil, under clods, stones, the loose bark of trees, &c., where they seem to remain in a semi-torpid state.

Their economy is in some respects rather remarkable, for the female, after she has laid her cluster of little oval, opaque, yellowish eggs, under a fallen leaf, or in any other sheltered spot, sits and nestles upon them as a hen does on her eggs, and probably also protects and feeds her young. Moreover, the earwig is an active creature as soon as it is hatched, and bears a considerable resemblance to its parent, but it is much smaller of course, and different in colour, destitute of wings, and the forceps are straighter and not horny. When they have arrived at what may be termed the pupa state, they present a still greater resemblance to the mature insects, having rudimentary elytra. They cast their skins from time to time, and immediately after this operation they are of a yellowish white colour, excepting the black eyes. Having arrived at their perfect and final state, both sexes are then provided with wings, which are most curiously folded upon the back, and nearly concealed beneath the little wing-cases. That these organs are sufficiently ample to sustain them in flight is not to be doubted, and the fact of one of the species, named *Forficula borealis*, having been taken in July on the wing, in the heat of the day, is a confirmation of the general opinion. It is, nevertheless, not the less remarkable that, having this power, they should so seldom avail themselves of it. It appears, however, that they take wing on moonlight nights. Earwigs now form a distinct ORDER, termed DERMAPTERA, and are included in the FAMILY FORFICULIDÆ. There are two species abundant in this country; the first is named—

27. FORFICULA AURICULARIA, *Linn.*

Head ovate; eyes small, lateral, and oval; the two horns inserted before the eyes, moderately long, thread-shaped, pubescent, and fourteen-jointed. The mouth is composed of an upper lip, of a transverse oval form; on either side is a horny mandible or jaw, trigonate, one cleft at the apex, the other concave and forming an angle at the middle. Opposed to the upper lip is the under lip, which is elongated, pilose, and dilated. The two palpi or feelers are three-jointed and rough, with short hairs. On each side are placed the

* *The Zoologist*, vol. vii. p. 2372.

maxillæ, which are rather elongated, furnished with two slender lobes, the internal one rigid, pointed, and cleft at the apex, the interior margin fringed with spines above and hairs below, external lobe curved, linear, rounded at the apex; palpi or feelers rather long, hairy, and five-jointed; the thorax or trunk not larger than the head, margined, orbicular-quadrate; scutellum concealed; the elytra or wing-cases attached beneath the thorax, and lying parallel on the back, oblong, coriaceous, without nervures; the two wings are delicate, ample, with numerous radiating nervures, folded several times, one lying under each elytron, with a small portion projecting beyond it: abdomen broader than the elytra, nine-jointed in the male, with a small elevated knot on each side of the second and third joints, and also at the apex; seven-jointed in the female; the apex furnished with a pair of moveable forceps, curved and toothed in the male; curved only at the apex in the female. It has six legs, hinder pair a little the longest; thighs thickened; the feet three-jointed, the second joint is heart-shaped, and the third terminated by two slender acute claws.

The *male* is 7 lines long; ochreous, head rufous, disk of thorax pitchy: abdomen castaneous; forceps much shorter than the abdomen, and very much curved. *Female* a little smaller; forceps nearly straight, attenuated, and finely serrated internally, except at the apex, which is curved. The other species has been named—

28. F. BOREALIS, by *Leach*,

from its having been observed by him in the north of England and Scotland; but it is abundant everywhere. The male is 8 or 9 lines long, ochreous; horns lurid, excepting the basal joint; head rufous; eyes black: disk of thorax pitchy; elytra lurid, the apex of the folded wings internally brown: abdomen chestnut-coloured, pitchy at the base and apex; forceps nearly as long as the abdomen, moderately curved, stout, chestnut-coloured, ochreous at the base, with a strong tooth on the inside of each towards the base, where there are smaller teeth. The specimens I take to be females have the forceps less curved than in *F. auricularia.** It may be well to observe that there is a little earwig called *Labia minor* which might be taken by those who are ignorant of the transformations of these insects for a young earwig, but it is totally distinct from those just described; it seems to be attached to muckheaps and dunghills, from whence it sometimes emerges in swarms, covering everything around, having two beautiful wings, and delighting to fly in the sunshine.

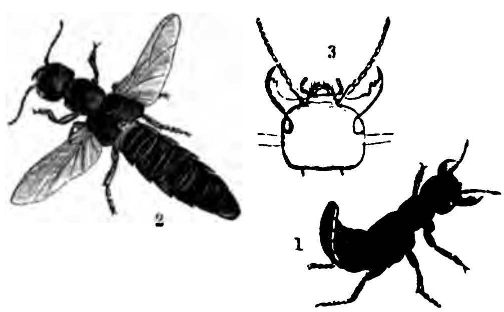
* See Curtis's *British Entom.*, fol. and Plate 560.

No doubt earwigs have many enemies in the smaller birds and reptiles, but I am not aware of any parasites having been discovered to keep them in check. There are some beetles, however, which prey upon them, and one of the most formidable enemies of the earwig is a long, black Rove-beetle, named—

29. STAPHYLINUS (*Ocypus*) OLENS, *Fab.—the Fetid Rove-beetle,* well known in this country as the "Devil's Coach-horse."

It is of a dead-black colour, thickly punctured all over with the minutest points, and thickly clothed with very short but stiff and fine black hairs, which in the sun appear iridescent. The head is very broad and depressed, as well as the rest of the body; the eyes are small and lateral; the two horns are rather short, a little tapering, pubescent, and eleven-jointed, the basal joint being long, and the terminal one somewhat claw-shaped: it has two uncommonly strong and powerful jaws, which can be opened very wide; they are curved, with an edge for cutting, and there are two teeth on the inside of each, with a fringed, leathery appendage near the middle; the upper and under lips and the maxillæ form the rest of the mouth, together with the four feelers, which are hairy and jointed, the external having four joints, the others, which are much smaller, being only three-jointed (No. 68, fig. 1; the head and mouth magnified): the trunk is somewhat orbicular; the scutel is small; the elytra when closed are nearly quadrate, and cover the two wings, which are much shorter than the body, and are folded up in repose; they are stiff and yellowish, with a few nervures, and are not sufficiently ample to enable the animal to fly: the body is more than half the entire length of the beetle, and tapers towards the apex, being composed of six and seven segments, with a little hairy process on each side of the apex: the six legs are strong, the anterior coxæ are very stout and powerful; the thighs and shanks are short; the latter have spines at the apex, and are bristly all over; the feet are five-jointed; the anterior are short, ovate, dilated, and very velvety or cushioned on the under-side; the first four joints are heart-shaped, the fifth is slender and clavate, terminated by two claws; the other feet are linear, the basal joint is the longest: length sometimes 1¼ inch—(fig. 2, standing; fig. 3, with the wings spread).

No. 68.



The Fetid Rove-beetles are abundant during the whole of September in meadows and wherever grass grows, and they continue so in some seasons to the middle of October, or until frosts set in; at that time we see them in roads and the footpaths in fields and pastures, where they are often trodden upon during the night, at which period they come out from under stones and other hiding-places to ramble about for prey. There can be no doubt that many of these beetles live through the winter, as we find them occasionally in the month of March. It is one of the largest Rove-beetles (as the *Staphylinidæ* are called) in Europe, but it seems to be principally an inhabitant of the more temperate parts, and it is very remarkable that it was never found in Sweden by Linnæus, to whom it seems to have been unknown; it is said at the present day to be rare in that country, and is only met with in the southern provinces.

The larvæ of this insect are as ferocious as the parent beetle, feeding entirely upon animal substances, and even devouring each other. They live principally underground, and in turning over the soil they are frequently met with in the spring. As they are then full grown, the eggs are, it may be presumed, laid the previous autumn, and the larvæ continue feeding throughout the winter.* When they change to pupæ, it is said that they retire under stones, and form an oblique hole in which to undergo their transformation, which takes place in a few days after, and at the end of fifteen or sixteen more the beetle is produced. It is at first yellowish, but attains its black colour in about twenty-four hours. The larvæ have a head somewhat like the beetle, but the jaws are not toothed internally; they are black and shining, as well as the three first or thoracic segments: the remainder of the body is ash-coloured, spotted with darker spots, a line down the back, and the sides ochreous and hairy; the mouth, horns, and six legs rust-coloured; the tail is furnished with a prehensile foot and two slender hairy appendages; the pupa is entirely ochre-coloured. (We have taken this description of the larva and pupa from M. Blanchard's notice of them in Guérin's *Mag. de Zool.*, where figures are given in Plate 165.)

The Fetid Rove-beetle must destroy a great number of earwigs, for, on confining one under a tumbler with some of those insects, the beetle despatched and ate four of them in the space of an hour and a half. It is curious to see the beetles seize the earwigs, dividing their bodies, clipping off their heads, eating the contents of the body, and rejecting the horny covering.

Of all the insects to which pasture-lands are a permanent resort, there are none more abundant and more injurious to the neighbourhood than those which live underground and feed upon the roots of most of the other plants,

* It is, however, far from improbable that they remain in the larva state for a much longer period.

as well as of the grasses, which grow in meadows, marshes, and pasture-lands.

Amongst these are the caterpillars called "Surface-grubs," of which we have, on a former occasion, spoken at large.* Probably a very large number of species of this family are of similar habits. Of *Noctua* (*Agrotis*) *exclamationis*, *A. segetis*, and *Triphœna pronuba*, we need here only record the ravages; but we must notice more particularly the economy of another moth, which sometimes destroys in its larva state a very large portion of pasture-land. Although it is in the mountainous districts of Europe that these caterpillars have so greatly abounded, yet in this country they are far from uncommon. They are also abundant in Scotland and Ireland. The moths appear in July and August; they belong to the Family Noctuidæ, and have received the name of—

30. Noctua graminis, *Linn.*—*The Antler-moth.*

This species has also the generic names of *Charæas*, *Episema*, and *Cerapteryx.*† The horns are bipectinate in the male, slightly pubescent in the female. The palpi or feelers in front of the face conceal a slender spiral proboscis, which is as long as the horns. The males are smaller than the females. It is reddish or fuscous brown: wings slightly deflected when at rest: superior wings with pale nervures, the central one ochreous, an oblong spot at the base of the same colour, an oblong conic spot towards the middle, and an oval or ovate one above it duller; beyond the middle is an ear-shaped spot, resting on a trifid character, both ochreous; these are relieved by a dark-brown or black tint, with a line of spots of the same colour between the nervures near the posterior margin: under wings and body blackish or smoky, sometimes palest at the base, the former with a dark spot in the centre: the tip of the body in the males is ochreous, with a smoky line along the middle in the upper wings: expanse of wings, 1 inch 6-8 lines.

The caterpillars are an inch long, with six pectoral, eight abdominal, and two anal feet, smooth, and of a dull gray-brown or blackish colour, with three yellow lines down the back and sides, which meet at the apex; the first and last segments are protected by a horny, smooth scale. They are full-grown about midsummer, when they often leave their subterranean abodes in search of some eligible spot wherein to change to chrysalides, which they do in slight webs, in moss, under stones, &c. The food of the caterpillars consists of all kinds of tender grass, but, according to Linnæus, they will not touch the *Alopecurus pratensis* nor the *Trifolium pratense*. They live on the roots

* Chapter v. p. 120.

† Curtis's *British Entomology*, fol. and Plate 451.

and eat away all shoots. This insect has been particularly observed in Sweden, in Norway, in Northern Germany, and even in Greenland, and does great mischief to grass-plots and meadows. It is also recorded to have done very great injury in the eastern mountains of Georgenthal, as well as at Töplitz in Bohemia, where caterpillars were in such large numbers that in four days and a half 200 men found 23 bushels of caterpillars, or 4,500,000, in the 60 bushels of mould which they examined. In Germany it seems to be confined to high and dry districts, and it never appears there in wet meadows or marshes, but its devastations are sometimes most extensive, as happened in the territory of the Hartz in 1816 and 1817, when whole hills that in the evening were clad with the finest green, were brown and bare the following morning; and such vast numbers of the caterpillars were there that the ruts of the roads leading to the hills were full of them, and the roads being covered with them were even rendered slippery and dirty by their being crushed in some places.* It is suggested by Köllar to dig or plough a deep and broad trench round the affected spot, and then turn in pigs to eat up the caterpillars. Rooks and crows are also very serviceable in rendering their assistance. The continued rains which often fall about midsummer generally keep this enemy in check, as they bring destruction to the caterpillars when they are changing their last skin, as was the case in Germany. I well remember, when Mr. Dale and myself visited Keswick in July, 1827, that the grass on a large portion of one side of Skiddaw appeared dead, and we found multitudes of the caterpillar of the antler-moth crawling about. In other parts of England I have observed the moths on heaths, in meadows, on the flowers of the ragwort, and even in marshes, which induced me to believe that they were bred there.

To arrest the ravages of these caterpillars the following remedies have been proposed—the application of "a strong dressing of lime to the land in the spring, or watering the fields and meadows with lime-water in damp weather, or strewing the ground with ashes of coal, peat, or turf, or lye-ashes."

Occasionally on the Continent the ravages of the caterpillar of the *Agrotis segetis* (above referred to) are fearful, as will be seen by the following account from the *Ann. Soc. Ent. de France*, iii. 19:—

"M. Louis Coulon, of Neufchâtel in Switzerland, stated that the pasturage of the Jura had been devoured in June (1833) to such an extent by the caterpillars of *N.* (*Agrotis*) *segetis* and the larva of *Galeruca Tanaceti* that they were not able to put the cattle there. The first devours the roots, the second

* Köllar's *Treatise on Insects*, London Trans., 105–136.

the extremities of the grass which had not yet withered in consequence of the ravages of the caterpillars. People some way off even heard the noise which these larvæ made in eating, and the yellow tints which spread over the pastures indicated their presence."

As this beetle is frequently exceedingly abundant in England, I will add a description of it. It belongs to the FAMILY CHRYSOMELIDÆ, and is named—

31. GALERUCA TANACETI, *Linn.*

It is oval, and dull black, deeply and roughly punctured: the horns are not so long as the body, filiform, pubescent, and eleven-jointed: the thorax is broader than long, the sides rounded: the wing-cases are much broader, oval; they have about five faintly elevated lines; wings ample: body of the female sometimes very large and extending beyond the elytra: the thighs are stout; the shanks thickened towards the apex, which is bristly; the feet are broad and five-jointed; the third joint is bilobed, the fourth very minute, the terminal joint clavate, with two claws: length from 4 to 6 lines. The larva of this beetle is somewhat lanceolate, composed of about twelve segments, spined and brown, with six pectoral feet: pupa ochreous (*Ræsel*, v. 2, class 3, t. 5). This common species inhabits the north and south of England. It is found in May, June, September, and October, in chalk-pits, and sometimes in profusion on sandhills near the sea. It occasionally frequents the ears of barley, and sometimes the beetles are of a brown colour.*

The genus of Gnats comprised under the name of *Tipula* are in the larva state amongst the most formidable enemies which the farmer and gardener have to contend with. There is not a crop of corn, of turnips, mangel-wurzel, or potatoes, which may not fall a sacrifice to what have been significantly termed, from their toughness, "Leather-jackets," and there are but few crops in the kitchen garden which escape their attacks. Wherever grass will grow, however scanty, these larvæ are generated, and of course pasture-lands, meadows, and marshes give birth to myriads of crane-flies, which issue forth from their subterranean abodes as they emerge from their pupa cases, during summer, until late in the autumn when frost sets in, to pair and scatter their eggs over the length and breadth of the land. There are upwards of thirty British species of the genus *Tipula*, all of which find a home on grass-lands; but there are only three whose economy has been sufficiently investigated to enable us to speak positively as to the damage they occasion in fields and gardens: they are—*T. oleracea*, Linn.; *T. paludosa*, Meig.; and *T. maculosa*,

* Curtis's *British Entomology*, fol. and Plate 371.

Hoff. As these species have been already carefully described and figured, we shall not here enter further upon their history.*

Another most destructive larva in pasture-lands is that of a pretty beetle called—

32. Anisoplia horticola.

This beetle is exceedingly abundant in May and June in corn fields, hedgerows (especially when the whitethorn is in flower), and grass-lands. We will now fulfil our promise, made in a former chapter, of calling attention to the economy of these beetles, and the means which have been suggested for the destruction of the larvæ.† They are so abundant every year, and so well known in every part of the kingdom, that these beetles have been called by various names, as field-chafers, May-bugs, bracken-clocks, fern-shaw beetles, chovies, &c. The female, having deposited about a hundred eggs in the earth, dies, and the larvæ hatch and commence their attacks upon the roots of the grass. Although they are mischievous in gardens, it is in pasture-lands and lawns that they commit the greatest ravages; by their consuming the roots, the grass dies; the dead turf becomes rotten, and will sink in patches under the feet, owing to the burrows which the maggots have made in the earth; and the rooks and starlings add to the disorder by pulling up the turf to feed upon them. The May-bug maggots were exceedingly abundant in the autumns of 1839 and 1840 in Hampshire and Gloucestershire, and again in 1844 in various localities. It is stated that they continue feeding for three years, and they generally reside about an inch beneath the turf; but as winter approaches they retire deeper into the earth; and even in November, when frost has set in, they have been found buried a spade deep. From the large size of most of them at this period, I expect they are generally full-grown and prepared to enter the pupa state, for which purpose they form cells in the earth, and in all probability remain in that quiescent state until the following spring, when the beetles emerge about the time the roses flower. They then feed on the anthers and pollen, consuming also the petals and riddling the leaves. The May-flowers are likewise an acceptable repast. When these no longer afford them a supply of food, they resort to corn fields to feed on wheat and oats; still later they have been known to congregate on acacias, and occasionally in such numbers that when the trees have been shaken the beetles have fallen down like a shower of hail.

To kill these larvæ, water the grass in the autumn with one-tenth of gas-liquor to nine-tenths of water: it will do no mischief to the grass, but will

* Pages 445–449, No. 61, figs. 1–4.

† For descriptions and figures, see page 219–221, No. 32, figs. 3–5.

vated as arable for five years and then laid to grass again, their value would be increased five-fold at the least."

Ants and their history are so well known that we need here only take a cursory view of them. They belong to the ORDER HYMENOPTERA, and the FAMILY FORMICIDÆ. Like bees and wasps, each colony is composed of three different kinds of individuals, which are readily distinguished from each other—viz. males, females, and neuters. Both of the first two are winged, but after impregnation the female pulls off her wings and retires into the earth to deposit her eggs, amounting to four or five thousand. The neuters, which never have any wings, form by far the most numerous portion of each colony, being those ants which we see so busily employed in transporting seeds and all sorts of materials into their nests or ant-hills, and which seem to be never at rest. When the eggs hatch the larvæ or maggots are fed by these neuters, and, when they are full-grown, each spins an oval, tough, light-coloured case or cocoon, in which it changes to a pupa. These are erroneously termed "ants'-eggs," and in this particular they differ from another genus of ants which we shall notice hereafter.*

Eight or nine species of true ants comprised in the GENUS FORMICA have been found in this country, but the following only are connected with our present subject, viz.:—

36. FORMICA SANGUINEA, *Latr.*

Nests of this species are found on heaths in various parts of the south of England in July and August.

37. F. FLAVA, *Latr.—The Turf-Ant—*

is abundant on heaths and in meadows, where it forms its conical nest, and is found in the middle of April, the end of June, in July, and the beginning of September. The other GENUS of ants alluded to is named MYRMICA, of which there are seven or eight different kinds inhabiting Great Britain, but it is principally the following species which affect pasture-lands. Like the true ants, there are three different sexes, which undergo similar transformations, but it is singular that the larvæ or maggots spin no cocoons, and are consequently naked pupæ.

38. M. RUBRA, *Linn.—The Red Ant—*

inhabits meadows, heaths, and banks, and is the principal agent in forming hillocks on pasture-lands.

* For figures and descriptions of the horse-ant, *Formica rufa*, see Curtis's *British Entomology*, fol. and Plate 752.

39. M. PERELEGANS, *Curt.**

This species is rarely found on heaths, forming colonies under stones in July.

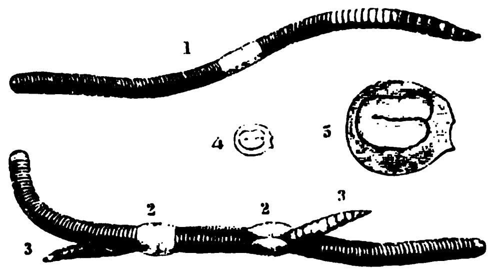
The following appear to me to be the simplest modes of ridding pasture-lands of ant-hills. Mr. Marshall, in his *Rural Economy of Norfolk*, vol. ii. p. 10, says—

"In Norfolk they burn the ant-hills on commons, by which means they get good manure from the ashes, improve the pasturage, and rid themselves of a great nuisance. The plan is to cut up the ant-hills, and dry first the under and then the upper sides; they are then burned in a heap."

It has been also recommended, in order "to destroy ant-hills in meadows," to "divide them with a sharp spade into four quarters, pare off the turves, and fold them back; then dig out the contents of the ant-hill, throwing and spreading them about until a hollow be left, in which the rains will collect, and, with the frost, destroy the broods; afterwards return the turves, which will be nearly flat, and make the surface green and even. This 'gelding' is most beneficially done between Michaelmas and Christmas for the above reasons, and the grass will be established before the scorching heat of summer can affect it."—*Gardeners' Chronicle.*

The dew or earth worm, LUMBRICUS TERRESTRIS (No. 69, fig. 1), is well deserving the farmer's notice, as it is not only universally distributed over his land, but is an active agent in pastures and meadows, in irrigating and manuring the soil, principally by its innumerable burrows and the fine earth which it casts out of them. Mr. Darwin has asserted "that a field, manured with marl, has been covered, in the course of eighty years, with a bed of earth averaging 13 inches in thickness," through the agency of earthworms.† Worms, like snails and slugs, are hermaphrodite, yet they pair and unite at the rings (figs. 2), embracing each other, the heads protruding, as

No. 69.



* See *Trans. Linn. Soc.*, vol. xxi. p 211, for descriptions and figures of the species by the author.

† For an interesting account of the earthworm we recommend to the perusal of the reader a little work which has recently appeared, entitled *The Earthworm and the Housefly*, with microscopic illustrations, by James Samuelson and J. B. Hicks, M.D.

at figs. 3. They so much resemble living muscle that a large fly, named *Sarcophaga carnaria** (Linn.), has been known to lay its eggs on worms, which hatched and turned to maggots, feeding upon the worms as they would have done on the dead flesh of any animal, and changing, when full-grown, to pupæ, from which flies again emerged.

Worms lay eggs (fig. 4; 5, magnified) principally in the spring; they may be seen coiled up within the pellucid egg; and when the worms hatch they are about 1 inch long, but when full-grown they sometimes attain to an extraordinary size, being nearly 1 foot long, and as thick as a large swan's quill. It is almost needless to observe that worms are usually cylindrical, fleshy, composed of numerous rings, and of a rosy colour, but this varies to whitish or bluish tints in certain soils and localities. The anterior portion is of a livid colour, with a bluish or iridescent gloss, the head being very pointed, and the tail flattened.

A solution of salt and water will destroy worms, as will also corrosive sublimate, but one of the easiest and most efficacious modes of extirpating worms is to water the land with lime-water. It is, however, said that, while unslaked stone-lime is efficacious, *lime of chalk* has no effect upon them.

This volume, which I have now brought to a close, will convince every one that the cultivator of the soil has multitudes of enemies to contend with, many of them difficult to detect, from their minuteness and obscure economy. To make the farmer acquainted with the habits of these enemies, and enable him to recognize them under their different aspects of egg, caterpillar, pupa, and perfect insect, has been the object. The utility of this knowledge cannot be denied, and without ample descriptions and good figures it is impossible to identify such minute animals, which often resemble each other in an extraordinary manner, even where their food is of a totally different nature. The first step towards vanquishing an enemy is to ascertain correctly his habits; the next, to be so certain of his appearance as not to mistake one party for another; and a third and no less important object is to be well acquainted with our allies and friends. For want of this it has often happened within my own knowledge, and indeed it is a notorious fact, that the very insects ordained by the Creator to keep noxious species in check have been mistaken for the offenders; and thus the most serviceable auxiliaries have been persecuted, and even sacrified to our ignorance of their deserts.

I cannot but hope that I have been permitted to lay a foundation towards

* *Gardeners' Chronicle*, vol. vi. p. 275.

a knowledge of the insects injurious to man, on which a more sound and perfect superstructure may be gradually raised, as materials are collected to increase and correct the mass of information which I have gathered together. As such observations are very tedious and difficult, the materials can be collected but slowly: if, however, every new discovery be faithfully and accurately recorded, it is impossible to calculate the happy results which may accrue towards averting the losses sustained from the attacks of insects. But I wish to impress in the strongest manner the absolute necessity of the agricultural observer, however talented he may be, calling in the aid of the scientific entomologist in his investigations, with the view of ascertaining the scientific name of the insect, and thus acquiring the means of referring to all that is known in relation to it; without this his discoveries will be but the "baseless fabric of a vision," and remain without "a local habitation and a name."

I will now bid farewell to my agricultural friends in the good old English phrase, "May God speed the plough!" I sincerely trust that my labours may tend not only to the instruction and to the benefit, but even to the amusement, of those engaged in the cultivation of the soil; and that the first step towards a correct knowledge of economic entomology may induce others to take up this important subject. After forty years' service in this labour of love, it is time for me to relinquish my pen and pencil, and release myself from my toil, which I cannot do better than in the words of the Mantuan bard, who delighted to sing of rural pursuits:—

> "For, overlaboured with so long a course,
> 'Tis time to set at ease the smoking horse." *

Explanation of Plate P.

Fig. 1. A head of *Trifolium pratense* (purple clover), divided to show five of the calyces eaten out by the maggots of *Apion apricans*. The orifices are indicated by brown spots.
Fig. 2. A calyx detached, showing the hole eaten by the maggot.
Fig. 3. The larva, or maggot, of *Apion apricans*.
Fig. 4. The same magnified.
Fig. 5. The pupa, or nymph, of ditto.
Fig. 6. The same magnified.
Fig. 7. *Apion apricans* or *flavifemoratum*.
Fig. 8. The same magnified.
Fig. 9. The mandible or jaw of *Apion frumentarium*, Linn.
Fig. 10. The maxilla and palpus, or feeler, of ditto.
Fig. 11. The chin or mentum and lip, &c., of ditto.

* "Sed nos immensum spatiis confecimus æquor:
Et jam tempus equûm fumantia solvere colla."—Virg. *Georg.* ii. 541-2.

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CLOVER CROPS & PASTURE LANDS.

Weevils and a Chrysomela, affecting Clover, Tares &c

PLATE P

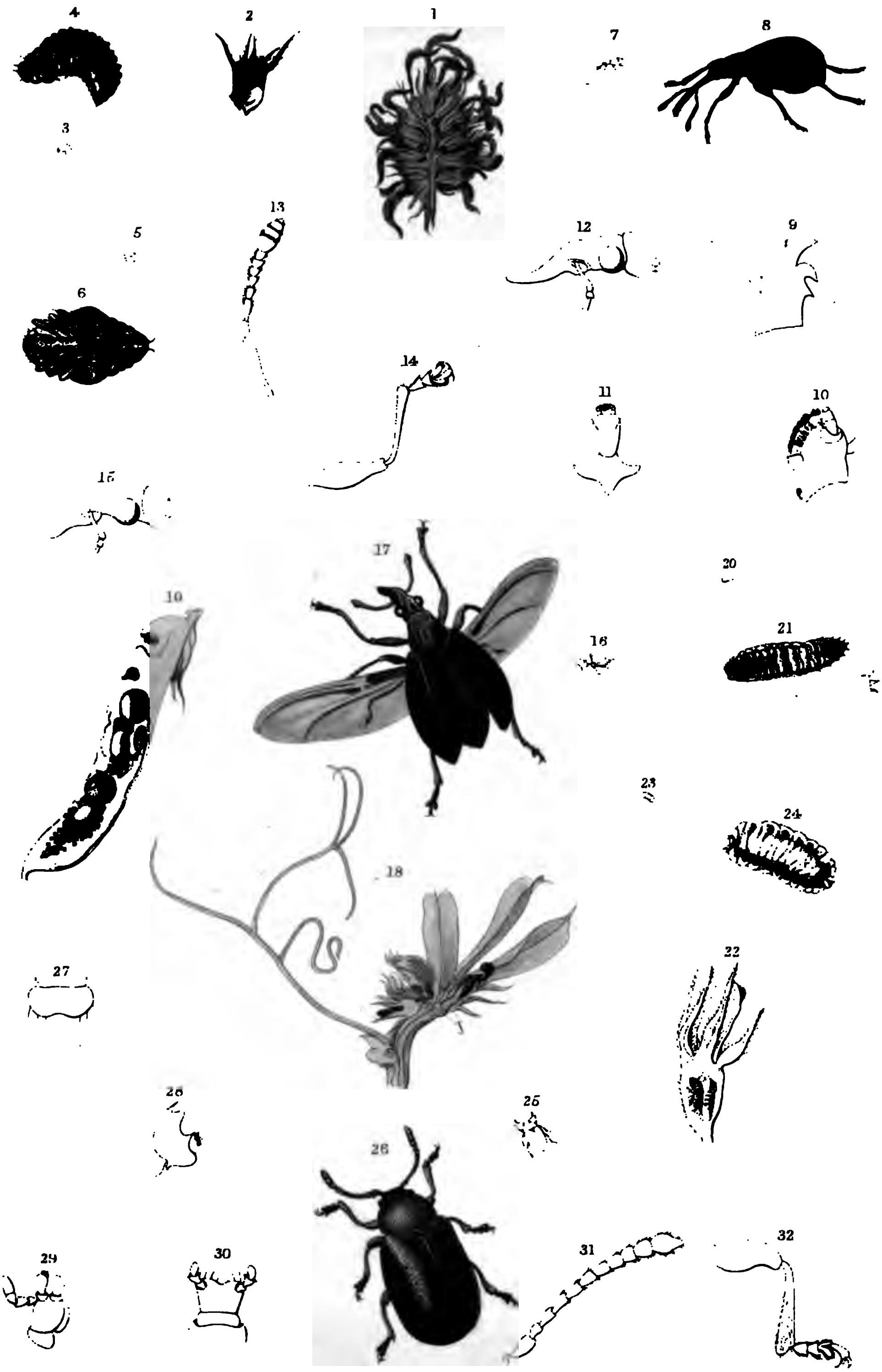

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Fig. 12. Head of the female.
Fig. 13. The horn or antenna.
Fig. 14. A leg.
Fig. 15. Head of the male.
Fig. 16. *Apion pomonæ*.
Fig. 17. The same flying and magnified.
Fig. 18. *Vicia sativa* (the vetch or tare), infested by *Apion pomonæ*.
l, The larvæ or maggots, in sitû.
Fig. 19. A pod of the vetch opened, exhibiting the perforated seeds.
Fig. 20. The larva of *Apion pomonæ* (?).
Fig. 21. The same magnified.
Fig. 22. A calyx of *Vicia sepium* (?), which contained several larvæ of some species of *Apion*.
Fig. 23. One of the larvæ, removed from the calyx.
Fig. 24. The same magnified.
Fig. 25. *Chrysomela* (*Phædon*) *polygoni*.
Fig. 26. The same magnified.
Fig. 27. The labrum or upper lip.
Fig. 28. One of the mandibles or jaws.
Fig. 29. One of the maxillæ, with the palpus or feeler.
Fig. 30. The labium or under lip, with the two palpi or feelers.
Fig. 31. The antenna or horn.
Fig. 32. One of the legs.

All the figures are drawn from nature.

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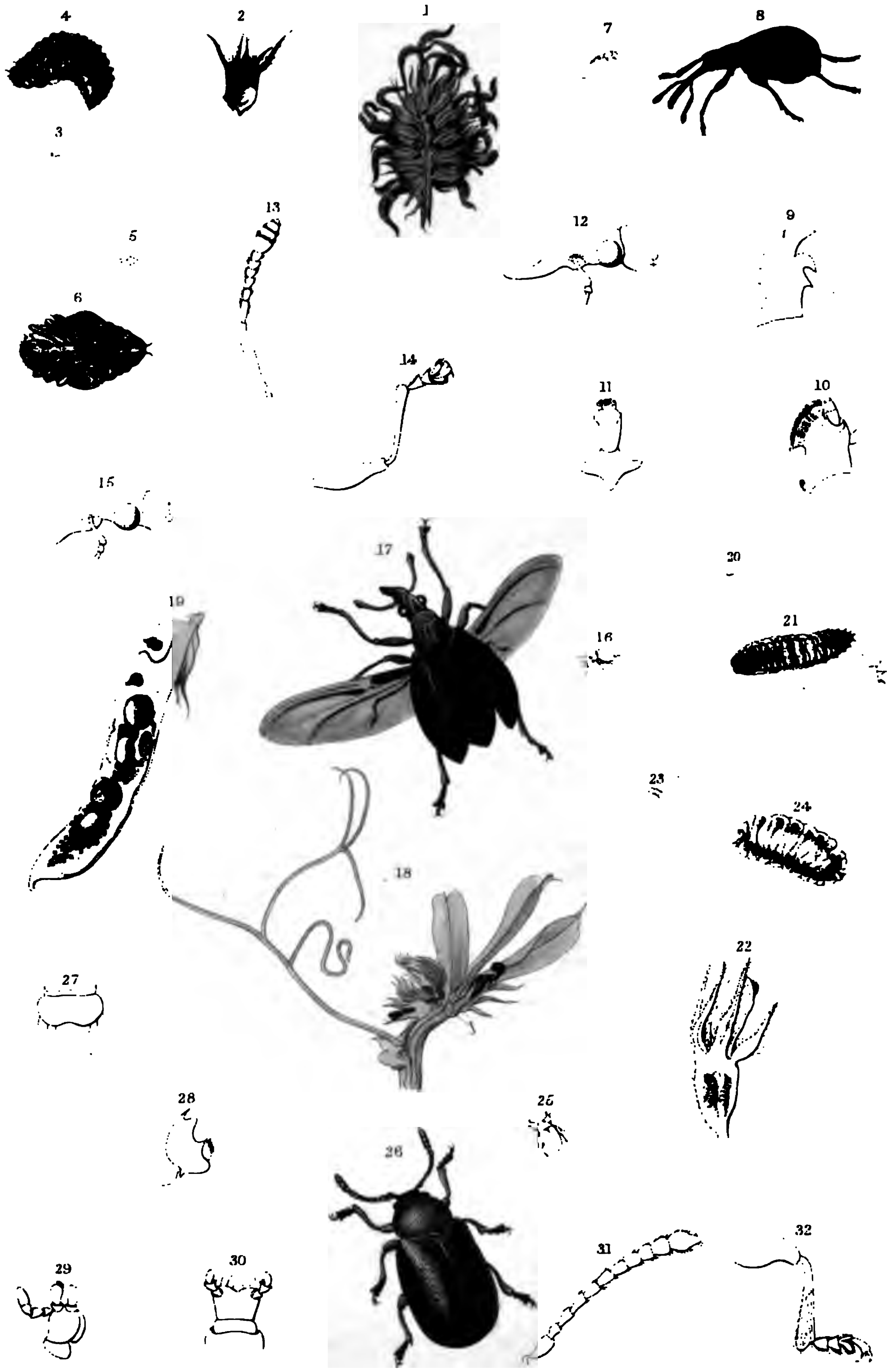
...s and a Chrysomela affecting Clover Tares &c

PLATE P



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